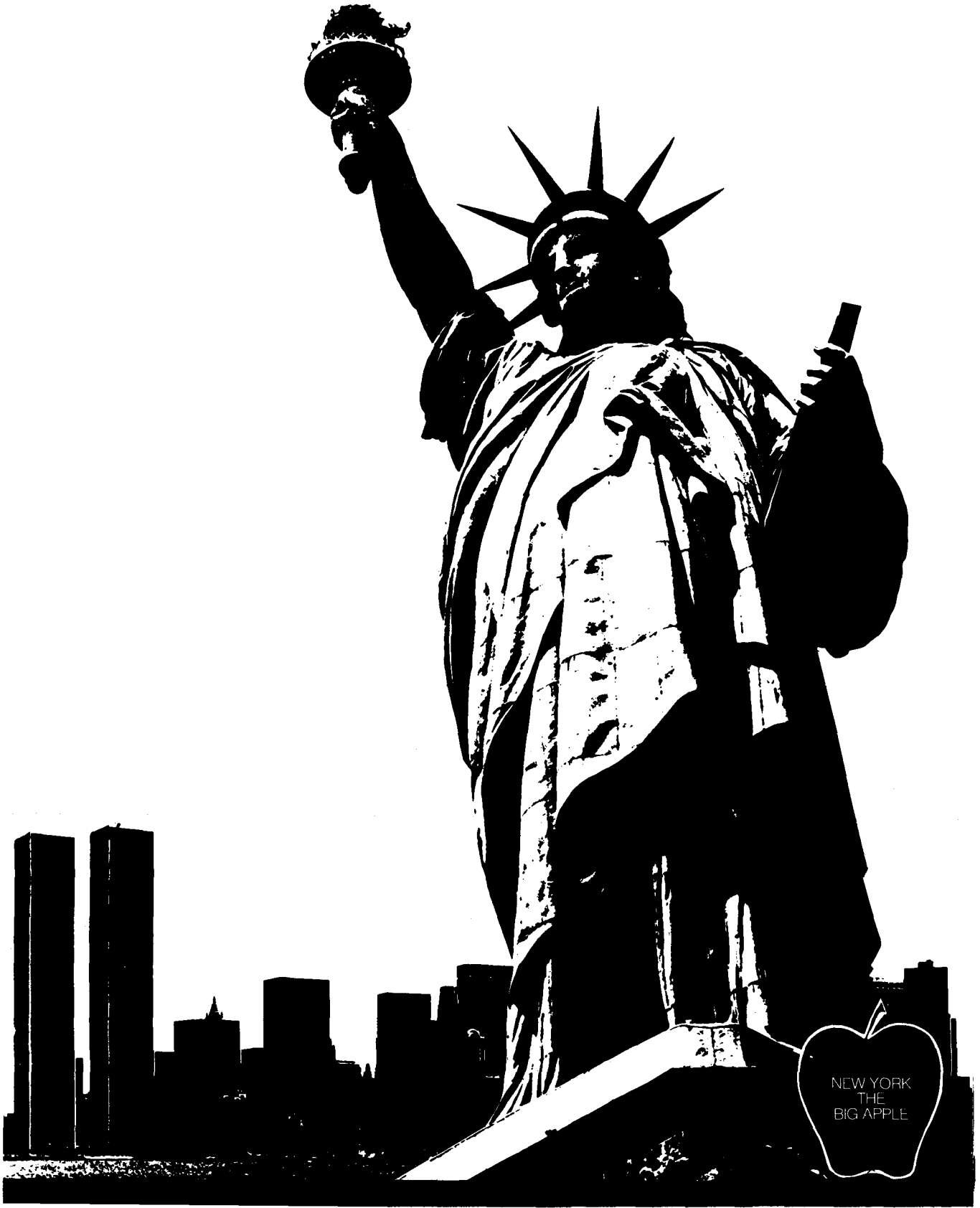
TECHNICAL PROGRAM

for the AOCS Annual Meeting

May 9-12, 1977 • New York City



MONDAY AFTERNOON—MAY 9

2:00 p.m.—Royal Ballroom A, 2nd floor

SESSION A—DEVELOPMENTS AND UPDATE IN EDIBLE FAT PROCESSING

Chairman: **Peter Kalustian,** Peter Kalustian Associates, Boonton, NJ

2:00 **1. AN UPDATE ON FILTRATION IN THE EDIBLE FAT INDUSTRY**
F. Passalaqua,* Industrial Filter and Pump Mfg. Co., Conroe, TX

2:15 **1A. CONTINUOUS SOLVENT FRACTIONATION**
M. Bernardini,* CMB, Pomezia, Italy

2:30 **2. HYDROGENATION CATALYSTS—YESTERDAY, TODAY, TOMORROW**
S.N. Milazzo,* Activated Metals and Chemicals Inc., Sevierville, TN

2:45 **3. ELECTRICAL SEPARATION OF SOLID MATTER FROM FATS AND OILS**
T.D. McLaren* and O. Wagner, Petreco Division, Petrolite Corp., Houston, TX

3:00 **4. DIRECT SOLVENT EXTRACTION OF HIGH OIL CONTENT SEEDS**
M. Bernardini,* CMB, Pomezia, Italy

3:15 **5. MANAGEMENT OF AN EDIBLE OIL BUSINESS**
R.E. Helland,* Capital City Products Co., Columbus, OH

3:30 **6. CHANGING TRENDS IN CONSUMER MARGARINES**
F.J. Massiello,* J.H. Filbert Co., Baltimore, MD

3:45 **DISCUSSION**

MONDAY AFTERNOON—MAY 9

2:00 p.m.—Georgian Ballroom B, 3rd floor

SESSION B—NOVEL BIOSYNTHESIS OF FATTY CHEMICALS

Chairman: **Lowell L. Wallen,** Northern Regional Research Center, ARS, USDA, Peoria, IL

2:00 **7. COMMERCIAL AND POTENTIAL UTILIZATION OF SOYBEAN LIPOXYGENASE**
E.A. Emken and E.N. Frankel,* Northern Regional Research Center, ARS, USDA, Peoria, IL

2:30 **8. THE PREPARATION OF FATTY CHEMICALS WITH LIPOLYTIC ENZYMES**
R.G. Jensen,* M.M. Hagerty, and K.E. McMahon, University of Connecticut, Storrs, CT

3:00 **9. MICROBIOLOGICAL TRANSFORMATIONS OF PROSTAGLANDINS**
C.J. Sih,* University of Wisconsin, Madison, WI

3:30 **10. INTERMEDIATES FROM THE MICROBIAL OXIDATION OF ALIPHATIC HYDROCARBONS**
A.J. Markovetz,* University of Iowa, Iowa City, IA

* **Speaker.**

MONDAY AFTERNOON—MAY 9

1:30 p.m.—Georgian Ballroom A, 3rd floor

SESSION C—ANALYTICAL METHODS: NUCLEAR MAGNETIC RESONANCE (NMR)

Chairman: **Philip E. Pfeffer,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

1:30 **11. ^{13}C NUCLEAR MAGNETIC RESONANCE, AN IMPORTANT NEW TOOL FOR THE LIPID CHEMIST**
P.E. Pfeffer,* Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

2:00 **12. ^{13}C SPIN RELAXATION AS A PROBE OF LIPID BILAYER STRUCTURE**
J.H. Prestegard,* Yale University, New Haven, CT

2:30 **13. APPLICATIONS OF ^{13}C NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY TO THE STRUCTURAL DETERMINATION OF LONG CHAIN COMPOUNDS**
A.P. Tulloch,* National Research Council of Canada, Saskatoon, Sask., Canada

3:00 **14. ^{13}C NUCLEAR MAGNETIC RESONANCE SPECTRA OF UNSATURATED FATTY ACID METHYL ESTERS**
J. Bus,* I. Sies, and M.S.F. Lie Ken Jie, Unilever Research, Vlaardingen, The Netherlands

3:30 **15. APPLICATION OF PULSED NUCLEAR MAGNETIC RESONANCE FOR DETERMINING THE SOLIDS CONTENT OF FATS AND SHORTENINGS**
B.L. Madison,* and R.C. Hill, Procter and Gamble Co., Cincinnati, OH

4:00 **16. THE PRAXIS SFC-900: AN INTEGRATED APPROACH TO SOLID FAT CONTENT DETERMINATION**
G.A. Persyn,* The Praxis Corp., San Antonio, TX

4:30 **17. QUANTITATIVE DETERMINATION BY ^{13}C NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY OF cis/trans RATIOS OF ALLYLIC HYDROPEROXIDES AND HYDROXIDES IN OXIDIZED UNSATURATED FATTY ACID ESTERS**
B.C.L. Weedon, R.F. Garwood, B.P.S. Khambay, and G.E. Hawkes, University of London, London, England, and E.N. Frankel,* Northern Regional Research Center, ARS, USDA, Peoria, IL

MONDAY AFTERNOON—MAY 9

2:00 p.m.—Royal Ballroom B, 2nd floor

SESSION D—POLLUTION PROCESSING IN THE FATS AND OILS INDUSTRY

Chairman: **Robert Casparian,** Carver-Greenfield Corp., East Hanover, NJ

2:00 **18. ODOR CONTROL IN EDIBLE OIL PROCESSING**
W.J. Gilbert,* Croll Reynolds Co., Westfield, NJ

2:30 **19. FAT AND OIL RECOVERY FROM PACKING HOUSE AND RENDERING OPERATIONS WASTEWATER BY ELECTROCOAGULATION**
E.R. Ramirez* and D.L. Johnson, Swift Environmental Systems, Oak Brook, IL

3:00 **20. FAT AND OIL RECOVERY FROM MEAT PROCESSING WASTEWATERS BY ELECTROCOAGULATION**
E.R. Ramirez* and O.A. Clemens, Swift Environmental Systems, Oak Brook, IL

3:30 **21. CARVER-GREENFIELD PROCESS FOR INDUSTRIAL WASTES**
C. Greenfield,* Dehydro-Tech Corp., East Hanover, NJ

4:00 **22. COALESCERS**
E. Herdenreich,* Hyde Products, Westlake, OH

4:30 **DISCUSSION**

MONDAY AFTERNOON—MAY 9

2:00 p.m.—Regency Foyer, 3rd floor

SESSION E—GENERAL SESSION: BIOCHEMISTRY

Chairman: **William Marmer,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

2:00 **22A. MEASUREMENT OF RATES OF FATTY ACID SYNTHESIS BY GAS CHROMATOGRAPHY AND MASS SPECTROMETRY**
G.M. Patton* and J.L. Lowenstein, Brandeis University, Waltham, MA

2:20 **23. INTERRELATED EFFECTS OF FOOD LIPIDS ON STEROID METABOLISM**
B.C. O'Brien, C.L. Skutches, G.R. Henderson, and R. Reiser,* Texas A&M University, College Station, TX 77843

2:40 **24. EFFECTS OF ETHANOL INGESTION AND DIETARY FAT LEVELS ON MITOCHONDRIAL LIPIDS IN MALE AND FEMALE RATS (HONORED STUDENT PRESENTATION)**
J.A. Thompson* and R.C. Reitz, University of Nevada, Reno, NV

3:00 **25. STIMULATION OF LIPID ABSORPTION IN YOUNG RATS BY CHOLESTEROL: EARLY TIME CHANGES**
J. Bitman,* J.R. Weyant, D.L. Wood, and T.R.

Wrenn, Animal Physiology and Genetics Institute, USDA, Beltsville, MD

3:20 **26. OCCURRENCE OF 2,3-DIACYL-1-ALKYLGLYCEROLS IN THE CUTANEOUS LIPIDS OF THE RHINO MOUSE**
M.H. Logani,* D.B. Nhari, and R.E. Davies, Temple University Health Sciences Center, Philadelphia, PA

3:40 **27. LIPOTROPIC EFFECTS OF INOSITOL AND CHOLINE IN THE RAT**
D.B. Andersen* and B.J. Holub, University of Guelph, Guelph, Ontario

4:00 **28. STUDIES ON THE UPTAKE OF BILE ACIDS BY THE ISOLATED PERFUSED RAT LIVER**
M.M. Fisher, B.R. Nagy, and I.M. Yousef,* University of Toronto, Toronto, Ontario, Canada

4:20 **29. A MODEL FOR STUDYING LECITHIN:CHOLESTEROL ACYLTRANSFERASE REACTION: IN VITRO CHOLESTEROL ESTERIFICATION IN PIG GRAAFIAN FOLLICULAR FLUID**
J.K. Yao,* S.C.S. Chang, R.J. Ryan, and P.J. Dyck, Mayo Clinic, Rochester, MN

4:40 **29A. LIPID PROFILES OF MAJOR PLASMA LIPOPROTEINS OF NORMAL SUBJECTS AND PATIENTS WITH HYPERLIPEMIA**
A. Kuksis,* J.J. Myher, K. Geher, W.C. Breckenridge, G. Steiner, J.A. Little, University of Toronto, Toronto, Canada

MONDAY AFTERNOON—MAY 9

2:00 p.m.—Regency Ballroom

SESSION EE—GENERAL SESSION

2:00 **30. DISTRIBUTION OF CHLORINATED PESTICIDES IN SOYBEANS, OIL AND BY-PRODUCTS DURING PROCESSING**
M.M. Chaudry,* A.I. Nelson, and E.G. Perkins, University of Illinois, Urbana, IL

2:20 **31. PHASE TRANSFER AGENTS. I. TRANSFER OF PERMANGANATE, PERIODATE, AND CYANATE IONS FROM AQUEOUS TO ORGANIC PHASES. PREPARATION OF QUATERNARY ONIUM PERIODATES**
T. Okimoto and D. Swern,* Temple University, Philadelphia, PA

2:40 **32. PHASE TRANSFER AGENTS. II. STEREOSPECIFIC HYDROXYLATION OF OLEYL AND ELAIDYL ALCOHOL AND PERIODIC ACID CLEAVAGE OF EPOXIDES**
T. Okimoto and D. Swern,* Temple University, Philadelphia, PA

3:00 **33. NONTOXIC LIPIDS AS BACTERIOSTATS FOR THE FOOD INDUSTRY**
J.J. Kabara* and R. Vrable, Michigan State University, East Lansing, MI, and M.S.F. Lie Ken Jie, University of Hong Kong, Hong Kong, China

3:20 **34. SURFACTANTS AS REPLACEMENT FOR NATURAL LIPIDS IN BREAD BAKED FROM DEFATTED WHEAT FLOUR**
O.K. Chung,* Y. Pomeranz, K.F. Finney, and M.D. Shogren, U.S. Grain Marketing Research Center, ARS, USDA, Manhattan, KS

3:40 **35. NEW RESINOUS RICINOLEIC POLYL FOR URETHANE REACTIONS**
M.C. Cooperman* and F.C. Naughton, NL Industries Inc., Hightstown, NJ

4:00 **36. AUTOMATION OF A MARGARINE BATCHING OPERATION**
A. Moustafa* and C. Struble, The Miami Margarine Co., Cincinnati, OH

4:20 **37. COMPOUND FORMATION OF SATURATED TRIGLYCERIDES**
T.C. van Soest,* Unilever, Vlaardingen, The Netherlands

4:40 **38. EFFECTS OF VARIOUS ENVIRONMENTS UPON THE FLUORESCENCE OF AFLATOXINS ON THIN LAYER CHROMATOGRAPHY PLATES**
P.F. Vornheder* and C.C. Stophlet, Jr., Procter and Gamble, Cincinnati, OH

TUESDAY MORNING—MAY 10

9:00 a.m.—Royal Ballroom A, 2nd floor

SESSION F—DEVELOPMENTS AND UPDATE IN PALM OIL PROCESSING AND APPLICATIONS

Chairman: **Peter Kalustian,** Peter Kalustian Associates, Boonton, NJ

9:00 **39. PALM OIL PROCESSING**
R. Hrushowy,* Canada Packers Ltd., Toronto, Canada

9:15 **40. FATE OF CAROTENOIDS DURING PALM OIL PROCESSING**
H. Daun* and S.S. Chang, Rutgers, The State University, New Brunswick, NJ

9:30 **41. INTERNATIONAL STANDARDS FOR PALM OIL**
J.A. Cornelius,* Tropical Products Institute, London, England

9:45 **42. USE OF TERTIABUTYL HYDROQUINONE IN STORAGE OF CRUDE PALM OIL**
J.E. Huffaker,* Eastman Chemical Products, Inc., Kingsport, TN

10:00 **43. PALM OIL FRACTIONATION**
R. Kassabian,* Anadik, Inc., North Bergen, NJ

10:15 **44. THE H.L.S. PALM OIL FRACTIONATING PROCESS**
H.L.S. Research Team, Petah, Tikva, Israel

10:30 **45. DEVELOPMENTS ON PALM OIL QUALITY**
M. Pike,* Harrisons and Crosfield, Camberley, Surrey, England

10:45 **DISCUSSION**

TUESDAY MORNING—MAY 10

9:00 a.m.—Regency Foyer, 3rd floor

SESSION FF—GENERAL SESSION: BIOCHEMISTRY

9:00 **46. REGULATION OF LIPOGENESIS IN AVIAN HEPATOCYTE CULTURE (HONORED STUDENT PRESENTATION)**
D.M. Tarlow* and M.D. Lane, Johns Hopkins Medical School, Baltimore, MD

9:20 **47. THE EFFECTS OF QUANTITY AND QUALITY OF DIETARY FAT AND CARBOHYDRATE IN VITRO SYNTHESIS OF PROSTAGLANDINS E_1, $E_{2\alpha}$ AND $F_{2\alpha}$ AND PLASMA FATTY ACID COMPOSITION IN IRRADIATED BEAGLE DOGS**
E.J. McCosh,* University of Connecticut, Storrs, CT, and J. Dupont, Colorado State University, Fort Collins, CO

9:40 **48. THE ACTIVATION OF A PLASMA MEMBRANE ENZYME BY CONCANAVALIN A IN POLYMORPHONUCLEAR LEUKOCYTES (HONORED STUDENT PRESENTATION)**
M. Hamrell* and P. Hochstein, USC School of Medicine, Los Angeles, CA

10:00 **49. STUDIES ON THE CHEMICAL COMPOSITION OF INTERNAL HUMAN HAIR LIPID**
O. Sakamoto,* Y. Fujinuma, and T. Ozawa, Shiseido Laboratories, Yokohama, Japan

10:20 **50. THE CONTRIBUTION OF QUANTITATIVE THIN LAYER AND GAS CHROMATOGRAPHIC ANALYSIS IN ELUCIDATING THE COMPOSITION OF DOG SKIN SURFACE LIPIDS**
D.M. Sharaf and D.T. Downing,* Boston University School of Medicine, Boston, MA

10:40 **51. WAX ESTERS IN THE K^n MUTATION OF THE DOMESTIC CHICKEN**
H.E. Walker* and R.G. Somes, Jr., University of Connecticut, Storrs, CT

11:00 **52. MATERNAL INFLUENCE ON HUMAN PLASMA CHOLESTEROL**
J.C. Christian* and K.W. Kang, Indiana University School of Medicine, Indianapolis, IN

11:20 **53. REVERSAL OF LINOLEATE INDUCED INHIBITION OF HEPATIC LIPOGENESIS BY EICOSA 5,8,11,14-TETRAYNOIC ACID (TYA)**
G. Ananda Rao,* Veterans Administration Hospital, Martinez, CA, and S. Abraham, Children's Hospital Medical Center, Oakland, CA

11:40 **53A. INFLUENCE OF ELECTROLYTES ON THE COLLOIDAL BEHAVIOR OF FABRIC SOFTENER SYSTEMS**
H.H. Hsing,* L. Hughes, M.L. Deviney, Ashland Chemical Co., Columbus, OH

TUESDAY MORNING—MAY 10

9:15 a.m.—Georgian Ballroom A, 3rd floor

SESSION G—LIPID THEORY OF ARTERIOSCLEROSIS—PROS AND CONS. I.

Chairman: **Hans Kaunitz,** Columbia University, New York, NY

9:15 54. THE DECISIVE ROLE OF DIETARY CHOLESTEROL AND FAT IN THE PREVENTION OF ATHEROSCLEROSIS
W.E. Connor,* University of Oregon, Portland, OR

9:45 55. DIETARY PROTEIN IN RELATION TO ATHEROSCLEROSIS
K.K. Carroll,* University of Western Ontario, London, Ontario, Canada

10:30 56. FIBER IN HYPERCHOLESTEROLEMIA AND ATHEROSCLEROSIS
D. Kritchevsky* and J.A. Story, Wistar Institute, Philadelphia, PA

11:00 57. DIETARY FACTORS IN ARTERIOSCLEROSIS: SUCROSE
J. Yudkin,* London University, London, England

11:30 58. DIET AND HUMAN ATHEROSCLEROSIS
G.V. Mann,* Vanderbilt University, Nashville, TN

TUESDAY MORNING—MAY 10

9:05 a.m.—Georgian Ballroom B, 3rd floor

SESSION H—ANALYTICAL METHODS MASS SPECTROMETRY. I.

Chairman: **Edward G. Perkins,** University of Illinois, Urbana, IL

9:05 59. APPLICATIONS OF COMPUTER INTERPRETATION OF MASS SPECTRA AND HIGH PRESSURE LIQUID CHROMATOGRAPHY-MASS SPECTROMETRY TO LIPID RESEARCH
F.W. McLafferty,* Cornell University, Ithaca, NY

9:40 60. MASS SPECTROMETRY OF LIPIDS LABELED WITH STABLE ISOTOPES
W.K. Rohwedder,* Northern Regional Research Center, ARS, USDA, Peoria, IL

10:15 61. ANALYSIS OF α-BRANCHED CHAIN FATTY ACIDS BY GAS CHROMATOGRAPHY AND MASS SPECTROMETRY
T.A. Foglia,* Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

10:50 62. A SIMPLE GAS CHROMATOGRAPHY-MASS SPECTROMETRY TECHNIQUE FOR THE IDENTIFICATION OF ODORIFEROUS CONTAMINANTS IN FATS AND OILS
S.S. Lin,* J.K. Maines, and T.H. Smouse, Anderson Clayton Foods, Richardson, TX

11:25 63. MASS SPECTROMETRIC BEHAVIOR OF FATTY ETHER DERIVATIVES
M.E. Rennekamp,* P.J. Menardi, W.E. Link, and G.E. Sitz, Ashland Chemical Co., Dublin, OH

TUESDAY MORNING—MAY 10

8:30 a.m.—Regency Ballroom, 3rd floor

SESSION I—LIPIDS OF MARINE ORGANISMS. I.

Chairman: **Richard F. Lee,** Skidaway Institute of Oceanography, Savannah, GA

Cochairmen: **Carter Litchfield,** Rutgers, The State University, New Brunswick, NJ, and **Robert G. Ackman,** Department of the Environment, Halifax, Nova Scotia

8:35 64. HYDROCARBONS IN MARINE ORGANISMS AND SEDIMENTS OFF WEST GREENLAND
P. Johansen,* A. Büchert, and V.B. Jensen, Greenland Fisheries Investigation, Charlottenlund, Denmark

8:55 65. SEASONAL VARIATION IN THE FATTY ACID COMPOSITION OF NATURALLY OCCURING PARTICULATE MATTER WITH SPECIAL REFERENCE TO THE OCTADECAPENTAENOIC ACID
P. Mayzaud*, Station Zoologique, Villefranch-sur-Mer, France, and R.G. Ackman, Environment Canada, Halifax, Nova Scotia

9:15 66. THE LIPIDS OF MARINE, CILIATE PROTOZOANS OF THE ORDER SCUTICOCILIATIDA
D.H. Beach,* G.C. Holz, and G.G. Holz, Jr., SUNY, Upstate Medical Center, Syracuse, NY

9:35 67. IDENTIFICATION OF THE FREE AND BOUND STEROL(S) OF A NONPHOTOSYNTHETIC DIATOM, Nitzschia alba
M. Kates,* P. Tremblay, and R. Anderson, University of Ottawa, Canada, and B.E. Volcani, Scripps Institute of Oceanography, La Jolla, CA

9:45 68. ISOLATION AND STRUCTURE ELUCIDATION OF PHYSIOLOGICALLY ACTIVE FATTY ACIDS FROM MARINE SPONGE Plakortis sp. (BV-44)
J.S. Chib,* M.F. Stempien, Jr., R.A. Mierzwa, and G.D. Ruggieri, Osborn Laboratories, NY Aquarium, Brooklyn, NY, and A.K. Bose, Stevens Institute of Technology, Hoboken, NJ

10:15 69. WAX ESTERS DISTRIBUTION IN THE TISSUES OF A SEA ANEMONE, Metridium senile
J.C. Nevenzel,* Scripps Institute of Oceanography, La Jolla, CA

10:35 70. DEMOSPONGIC ACIDS: UNUSUAL C_{24}-C_{30} FATTY ACIDS FROM MARINE SPONGES
R.W. Morales, A.J. Greenberg, G. Noto, and C. Litchfield,* Rutgers, The State University, New Brunswick, NJ

10:55 71. NON-METHYLENE-INTERRUPTED DIENES IN DECAPOD CRUSTACEANS OF THE SOUTHEAST ATLANTIC OCEAN
J.D. Joseph* and D.S. Fender, Marine Resources Research Institute, Charleston, SC

11:15 72. PHOSPHATIDYL INOSITOL ACTIVITY AND ENDOCRINE PRODUCTION IN THE BRAIN OF THE POLYCHAETE Nereis virens
J. Marsden,* McGill University, Montreal, Canada

11:35 73. THE TROPHIC STRUCTURE OF AN ESTUARINE SEDIMENTARY ENVIRONMENT ELUCIDATED BY LIPIDS FROM THE BENTHIC ENDOFAUNA
J.J. Boon,* W. Liefkens, M. Baas, H. van de Schoof, and J.W. de Leeuw, Delft University of Technology, and P.J. de Wilde, Netherlands Institute for Sea Research, Delft, The Netherlands

TUESDAY MORNING—MAY 10

9:00 a.m.—Royal Ballroom B, 2nd floor

SESSION J—WORKSHOP: SAFETY IN SOLVENT EXTRACTION PLANTS, ROUNDTABLE DISCUSSION

Chairman: **C.L. Kingsbaker,** Dravo Corp., Pittsburgh, PA

74. REVIEW OF PROCESSING COMPANIES' SAFETY PROGRAMS
J.E. Heilman, Continental Grain Co., New York, NY; G. Martin, Quincy Soybean Co., Quincy, IL; H. Marxhausen, Cargill, Inc., Minneapolis, MN; R.L. Moeller, Ralston Purina Co., St. Louis, MO; P.M. Bell, Canadian Vegetable Oil Processing Co., Hamilton, Ontario, Canada; N.M. Witte, Central Soya Co., Fort Wayne, IN

75. NATIONAL FIRE PROTECTION ASSOCIATION BOOKLET NO. 36—SOLVENT EXTRACTION PLANTS, 1974
J. Heilman,* Continental Grain Co., New York, NY, and C.L. Kingsbaker,* Dravo Corp., Pittsburgh, PA

76. SAFETY IN EXTRACTION PLANTS FROM THE INSURANCE COMPANY ASPECT
L.J. Hall,* Mill Mutual Fire Prevention Bureau, Chicago, IL

77. DUST EXPLOSIONS RELATED TO EXTRACTION PLANTS
P.M. Bell,* Canadian Vegetable Oil Processing Co., Hamilton, Ontario, Canada, and L.J. Hall,* Mill Mutual Fire Prevention Bureau, Chicago, IL

78. REVIEW OF KNOWN FIRES AND EXPLOSIONS IN THE SOLVENT EXTRACTION INDUSTRY DURING THE PAST 25 YEARS AND ACTIONS

TAKEN TO PREVENT THEIR REOCCURRENCE
Panel and Discussion

79. SAFETY PROBLEMS NOW PREVALENT IN THE SOLVENT EXTRACTION INDUSTRY
Panel

TUESDAY AFTERNOON—MAY 10

2:00 p.m.—Royal Ballroom A, 2nd floor

SESSION K—TALL OIL, ROUNDTABLE DISCUSSION

Chairman: **Robert W. Johnson,** Union Camp Corp., Savannah, GA

2:00 82. MARKETING OF TALL OIL PRODUCTS
L.G. Zachary,* Union Camp Corp., Savannah, GA

2:15 83. PROCESSING TALL OIL
J. Drew,* Sylvachem, Jacksonville, FL

2:30 84. ANALYTICAL CHEMISTRY USED IN THE TALL OIL INDUSTRY
J. McBride,* Arizona Chemical Co., Wayne, NJ

2:45 85. APPLICATIONS FOR TALL OIL PRODUCTS
M.J. Kelly,* Hercules, Inc., Wilmington, DE

3:00 86. TALL OIL USED AS CHEMICAL INTERMEDIATES
C.W. Bailey,* Westvaco, New York, NY

3:15 86A. TALL OIL INDUSTRY IN EUROPE
J. Norman and J. Oxley, British Oxygen, England

3:30 ROUNDTABLE DISCUSSION

TUESDAY AFTERNOON—MAY 10

2:00 p.m.—Georgian Ballroom A, 3rd floor

SESSION L—LIPID THEORY OF ARTERIOSCLEROSIS—PROS AND CONS. II.

Chairman: **Hans Kaunitz,** Columbia University, New York, NY

2:00 87. CHOLESTEROL AND REPAIR PROCESSES IN ARTERIOSCLEROSIS
H. Kaunitz,* Columbia University, New York, NY

2:30 88. HYPERLIPIDEMIA AND PREMATURE ARTERIOSCLEROSIS
F.R. Smith,* Columbia University, New York, NY

3:00 89. EPIDEMIOLOGY OF ARTERIOSCLEROSIS IN CHILDHOOD
C.A. Neill,* Johns Hopkins University, Baltimore, MD

3:30 90. THE DEVELOPMENT OF CORONARY THROMBOSIS FOLLOWING MYOCARDIAL INFARCTION
A.W. Branwood,* Columbia University, New York, NY

4:00 91. NEURAL FACTORS IN EXPERIMENTAL DEGENERATIVE ARTERIOPATHY
W.H. Gutstein* and F. Parl, New York Medical College, Valhalla, NY

4:30 92. OVERVIEW
M. Winick,* Columbia University, New York, NY

5:00 DISCUSSION

TUESDAY AFTERNOON—MAY 10

2:05 p.m.—Georgian Ballroom B, 3rd floor

SESSION M—ANALYTICAL METHODS: MASS SPECTROMETRY. II.

Chairman: **Edward G. Perkins,** University of Illinois, Urbana, IL

2:05 93. APPLICATIONS OF COMBINED HIGH PRESSURE LIQUID CHROMATOGRAPHY-MASS SPECTROMETRY TO LIPID ANALYSIS
W.H. McFadden,* Finnigan Corp., Sunnyvale, CA

2:40 94. AN IMPROVED SYSTEM FOR INTERFACING LIQUID CHROMATOGRAPHY WITH A FLAME IONIZATION DETECTOR AND MASS SPECTROMETRY
W.L. Erdahl and O.S. Privett,* The Hormel Institute, University of Minnesota, Austin, MN

3:00 95. LOCATION OF DOUBLE BONDS IN FATTY ACIDS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY
R.D. Plattner and R. Kleiman,* Northern Regional Research Center, ARS, USDA, Peoria, IL

3:35 96. THE PYRROLIDIDE DERIVATIVE. THE IDEAL CHOICE FOR THE LOCATION OF SUBSTITUENT GROUPS IN FATTY ACIDS
A.J. Valicenti,* W.H. Heimermann, R.T. Holman, The Hormel Institute, University of Minnesota, Austin, MN

4:00 97. MASS SPECTRAL ANALYSIS OF UNSATURATED OXYGENATED FATTY ACIDS
R. Kleiman* and R.D. Plattner, Northern Regional Research Center, ARS, USDA, Peoria, IL

4:30 98. GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC ANALYSIS OF NATURALLY-OCCURRING ODOR COMPONENTS
R.T. Holman,* W. Heimermann, and A.J. Valicenti, The Hormel Institute, University of Minnesota, Austin, MN

TUESDAY AFTERNOON—MAY 10

1:10 p.m.—Regency Ballroom, 3rd floor

SESSION N—LIPIDS OF MARINE ORGANISMS. II.

Cochairmen: **Carter Litchfield,** Rutgers, The State University, Laboratory, Charleston, SC

Cochairmen: **Carter Litchfield,** Rutgers, The State University, New Brunswick, NJ, and **Robert G. Ackman,** Department of Environment, Halifax, Nova Scotia, Canada

1:10 99. COMPARATIVE STUDIES ON MOLECULAR SPECIES OF SPHINGOLIPIDS IN MARINE ANIMALS
A. Hayashi* and F. Matsuura, Kinki University, Higashiosaka, Japan

1:30 99A. FATTY ACIDS AND STEROLS OF THREE MICROSPORIDIA PARASITES IN *Carcinus mediterraneus* (CRUSTACEA, BRACHYURA) AND FATTY ACIDS OF THEIR HOST, HEALTHY AND CARRYING PARASITES
B.J. Martin, C.P. Vivares, and H. Ceccaldi,* École Pratique des Hautes Etudes, Station Marine d'Endoume, Marseilles, France

1:50 100. SERUM LIPOPROTEINS OF THE BLUE CRAB *Callinectes sapidus*
R.F. Lee* and S. Singer, Skidaway Institute of Oceanography, Savannah, GA

2:10 101. DISTRIBUTION, STRUCTURE, AND POSSIBLE PHYSIOLOGICAL FUNCTION OF SAPONINS IN THE STARFISH *Asterias rubens*
P.A. Voogt,* Laboratory of Chemical Animal Physiology, State University of Utrecht, The Netherlands

2:30 102. SEASONAL VARIATIONS IN THE LIPIDS OF TWO AMPHIPOD SPECIES, *Gammarus lacustris* G.O. Sars and *Hyalella azteca* Saussure
M. Yurkowski and J.L. Tabachek,* Environment Canada, Freshwater Institute, Winnipeg, Canada

2:50 103. LIPIDS OF THE EGG, HATCHLING, AND ADULT OF *Fundulus heteroclitus*
C.F. Bailey,* University of Arkansas, Fayetteville, AR

3:10 104. SEASONAL VARIATIONS IN THE LIPIDS OF FATHEAD MINNOWS (*Pimephales promelas* Rafinesque) AND BROOK STICKLEBACK (*Culaea inconstans* Kirtland)
M. Yurkowski* and J.L. Tabachek, Environment Canada, Freshwater Institute, Winnipeg, Canada

3:30 105. LUNG SURFACTANT SYNTHESIS IN AIR-BREATHING FISHES
C.F. Phleger,* San Diego State University, San Diego, CA

3:50 106. EFFECT OF DIETARY CHOLESTEROL ON OYSTERS, *Crassotrea virginica*
D.J. Trider* and J.D. Castell, Environment

Canada, Resource Branch, Halifax, Nova Scotia, Canada

4:10 107. LIPID METABOLISM OF CULTURED AND WILD ATLANTIC SILVERSIDE (Menidia menidia): THE FATTY ACID COMPOSITION OF THE TOTAL LIPIDS AND POLAR AND NEUTRAL LIPID CLASSES
P.S. Schauer,* A.D. Beck, and K.L. Simpson, University of Rhode Island, Kingston, RI

4:30 108. EFFECT OF DIETARY FATTY ACIDS OF DIFFERENT CHAIN LENGTHS AND SERIES ON THE GROWTH OF TURBOT Scophthalmus maximus L.
C. Leger,* J.F. Gatesoupe, and P. Luquet, Institut National de la Recherche Agronomique, JOUY-en-JOSAS, France. and R. Metailler, Centre National pour l'Exploitation des Oceans, France

4:50 109. COMPOSITIONAL TOPOGRAPHY OF MELON LIPIDS IN THE PYGMY SPERM WHALE Kogia breviceps: IMPLICATIONS FOR ECHOLOCATION
R. Karol* and C. Litchfield, Rutgers, The State University, New Brunswick, NJ

5:10 110. BIOSYNTHESIS OF BRANCHED CHAIN FATTY ACIDS IN ADIPOSE TISSUE OF THE DOLPHIN
H. Morii,* Nagasaki University, Nagasaki, Japan, and T. Kaneda, Tohoku University, Sendai, Japan

TUESDAY AFTERNOON—MAY 10

2:00 p.m.—Regency Foyer, 3rd floor

SESSION O—GENERAL SESSION: FLAVOR AND OXIDATIVE STABILITY OF OILS

Chairman: **Thomas A. Foglia,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

2:00 111. THE APPLICATION OF GAS CHROMATOGRAPHY-MASS SPECTROMETRY IN FLAVOR RESEARCH
D.B. Min,* Best Foods Research Center, CPC International, Union, NJ

2:20 112. INSTRUMENTAL ANALYSIS OF RESIDUAL SOLVENT AND FLAVOR QUALITY OF SOY PROTEIN PRODUCTS
E.T. Rayner, J.I. Wadsworth, M.G. Legendre, and H.P. Dupuy,* Southern Regional Research Center, ARS, USDA, New Orleans, LA

2:40 113. ELECTRON SPIN STUDY OF THE PATHWAY OF THE REACTION BETWEEN OXIDATION PRODUCTS OF UNSATURATED OILS WITH PROTEINACEOUS MATTER
F. Sundholm and A. Visapää, University of Helsinki, Helsinki, Finland, and J. Bjorksten,* Bjorksten Research Foundation, Madison, WI

3:00 114. FLAVOR AND OXIDATIVE STABILITY OF HYDROGENATED AND UNHYDROGENATED SOYBEAN OIL. EFFECTS OF ANTIOXIDANTS
T.L. Mounts,* K. Warner, G.R. List, J.P. Friedrich, and S. Koritala, Northern Regional Research Center, ARS, USDA, Peoria, IL

3:20 115. ANALYSES OF AUTOXIDATED FATS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY. METHYL LINOLENATE
E.N. Frankel,* W.E. Neff, and W.K. Rohwedder, Northern Regional Research Center, ARS, USDA, Peoria, IL, and B.P.S. Khambay and B.C.L. Weedon, University of London, London, England

3:40 116. TERTIARY BUTYLHYDROQUINONE ANTIOXIDANT IN FOOD FRYING OILS
E.R. Sherwin,* Eastman Chemical Products, Inc., Kingsport, TN

4:00 117. A COMPREHENSIVE COMPARISON OF THE OXIDATIVE AND FLAVOR STABILITIES OF SUNFLOWER OIL VS. CORN OIL (HONORED STUDENT PRESENTATION)
A.-S. Huang,* O. Hsieh, S.S. Chang, Rutgers, The State University, New Brunswick, NJ, and C.-L. Huang, Pharmacia, Inc., Piscataway, NJ

4:20 118. EFFECTS OF THERMALLY OXIDIZED CORN OIL ON THE LIPID COMPOSITION AND METABOLISM OF IN VITRO HEART CELLS
J.C. Alexander* and R.P. Bird, University of Guelph, Guelph, Ontario, Canada

4:40 119. SELECTIVE HYDROGENATION OF SOYBEAN OIL. VIII. EFFECT OF METHOD OF PREPARATION UPON THE ACTIVITY OF A COPPER-SILICA CATALYST
S. Koritala,* Northern Regional Research Center, ARS, USDA, Peoria, IL

5:00 120. SELECTIVE HYDROGENATION OF SOYBEAN OIL. IX. EFFECT OF HIGH PRESSURE ON COPPER CATALYSIS
T.L. Mounts,* S. Koritala, J.P. Friedrich, and H.J. Dutton, Northern Regional Research Center, ARS, USDA, Peoria, IL

WEDNESDAY MORNING—MAY 11

9:00 a.m.—Royal Ballroom A, 2nd floor

SESSION P—AN UPDATE ON SYNTHETIC FATTY ACIDS

Chairman: **Peter Kalustian,** Peter Kalustian Associates, Boonton, NJ

Cochairman: **Roger Logan,** Union Camp Corp., Wayne, NJ 07470

9:00 121. PRESENT SITUATION ON SYNTHETIC FATTY ACIDS
H. Fineberg,* Ashland Oil Co., Columbus, OH

9:15 122. DEVELOPMENTS IN SYNTHETIC FATTY ACIDS
N. Sonntag,* Glyco Chemicals, Inc., Williamsport, PA

9:30 123. NEO ACIDS—SYNTHETIC HIGHLY BRANCHED ORGANIC ACIDS
M. Fefer,* Exxon Chemical Co., Houston, TX

9:45 124. PRESENT AND FUTURE MARKET FOR SYNTHETIC FATTY ACIDS
R.M. Hull,* Hull and Co., Bronxville, NY 1070(

10:00 125. HEPTANOIC ACID
N.E. Lawson,* Union Camp Corp., Princeton, NJ

10:15 126. STRAIGHT CHAIN ALIPHATIC FATTY ACID ESTERS AND ISOMERIC ALIPHATIC FATTY ACIDS IN LUBRICANTS
E.J. Niedzielski,* DuPont Organic Chemicals Dept., Wilmington, DE

10:30 127. UPDATE ON SYNTHETIC FATTY ACIDS
K.T. Zilch,* Emery Industries, Cincinnati, OH

10:45 128. PROCESSING AND USES OF SYNTHETIC FATTY ACIDS
E. Fuochi,* L. Ferrara, and B. Berti, Liquichimica of America, 45 Rockefeller Plaza, New York, NY

11:00 DISCUSSION

WEDNESDAY MORNING—MAY 11

9:00 a.m.—Georgian Ballroom A, 3rd floor

SESSION Q—CURRENT PERSPECTIVES ON OBESITY

Chairman: **Marci Greenwood,** Columbia University, New York, NY

9:00 129. AN INTEGRATED APPROACH TO THE PROBLEM OF OBESITY
J. Hirsch,* R. Burr, I.M. Faust, B. Schneider, J. Grinker, and P.R. Johnson, Rockefeller University, New York, NY

9:30 130. METABOLIC CHARACTERISTICS OF OBESITY
A.C. Sullivan,* Hoffmann-La Roche Inc., Nutley, NJ

10:00 131. ASPECTS OF ADIPOSE TISSUE DEVELOPMENT IN RODENTS
P.R. Johnson,* Vassar College, Poughkeepsie, NY, and I.M. Faust and J. Hirsch, Rockefeller University, New York, NY

10:30 132. FAT CELL METABOLISM IN THE SPONTANEOUSLY OBESE RAT AND THE OB/OB MOUSE
M.P. Czech* and D.K. Richardson, Brown University, Providence, RI

11:00 133. DIET RELATED CALORIGENESIS
M.L. Kaplan,* Rutgers, The State University, New Brunswick, NJ

11:30 134. **HUMAN OBESITY: AN OVERVIEW**
T. Van Itallie,* Columbia University, New York, NY

12:00 **DISCUSSION**

WEDNESDAY MORNING—MAY 11

9:00 a.m.—Georgian Ballroom B, 3rd floor

SESSION R—INTERACTIONS OF LIPIDS AND CARBOHYDRATES WITH PROTEINS PERTAINING TO FOOD QUALITY

Chairman: **Allen J. St. Angelo,** Southern Regional Research Center, ARS, USDA, New Orleans, LA

9:00 135. **FLAVOR COMPONENTS IN FOODS PRODUCED BY THE OXIDATION OF LIPIDS**
S.S. Chang,* Rutgers, The State University, New Brunswick, NJ

9:30 136. **REACTIONS BETWEEN PEROXIDIZING LIPIDS AND HISTIDYL RESIDUE ANALOGUES: ENHANCEMENT OF HYDROPEROXIDE DECOMPOSITION AND BROWNING BY 4-METHYLIMIDAZOLE**
S.H. Yong,* and M. Karel, Massachusetts Institute of Technology, Cambridge, MA

10:00 137. **THERMAL INTERACTION OF LINOLEIC ACID WITH AMINO ACIDS**
S. Henderson* and W.W. Nawar, University of Massachusetts, Amherst, MA

10:30 138. **EVALUATION OF FACTORS AFFECTING THE BINDING OF POLAR AND NEUTRAL LIPIDS TO FISH ACTIN AND MYOSIN**
S.Y.K. Shenouda,* National Marine Fisheries Service, USDC, NOAA, Gloucester, MA, and G.M. Pigott, University of Washington, Seattle, WA

11:00 139. **INTERACTION OF LIPIDS WITH PROTEINS AND CARBOHYDRATES IN BREADMAKING**
Y. Pomeranz* and O.K. Chung, U.S. Grain Marketing Research Center, Manhattan, KS

11:30 140. **THE SIGNIFICANCE OF NATURAL POLYPHENOLS WITH RESPECT TO TASTE AND COLOR IN OILSEEDS AND CEREAL PROTEIN FOODS**
A.B. Durkee,* Food Research Institute, Canada

WEDNESDAY MORNING—MAY 11

9:00 a.m.—Regency Foyer, 3rd floor

SESSION S—ANALYTICAL METHODS: LIPIDS

Chairman: **Daniel P. Schwartz,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

9:00 141. **SEPARATION OF SATURATED FROM UNSATURATED COMPOUNDS USING A CELITE-PALLADIUM CHLORIDE COLUMN**
D.P. Schwartz,* Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

9:30 142. **RAPID DETERMINATION OF ACYL GROUPS IN MICROGRAM AMOUNTS OF PHOSPHOLIPIDS**
W.N. Marmer,* Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

10:00 143. **GLYCERIDE STRUCTURE VARIATION IN SOYBEAN VARIETIES**
S.H. Fatemi and E.G. Hammond,* Iowa State University, Ames, IA

10:30 144. **DETERMINATION OF ALPHA TOCOPHEROL IN PLATELETS BY GAS LIQUID CHROMATOGRAPHY**
J. Lehmann,* ARS, USDA, Agricultural Research Center, Beltsville, MD

11:00 145. **CHEMICAL IONIZATION MASS SPECTROSCOPY TECHNIQUES FOR CHARACTERIZATIONS OF LIPIDS**
A.K. Bose,* B.N. Pramanik, B. Patel, B.G. Pujar, and H. Fujiwara, Stevens Institute of Technology, Hoboken, NJ

11:30 146. **PRACTICAL APPLICATION OF THE METTLER DROPPING POINT AND STATISTICAL ANALYSIS OF ITS USE AS A WILEY MELTING POINT PREDICTOR**
I.E. Kocan,* Durkee Foods Division, SCM Corp., Strongsville, OH

WEDNESDAY MORNING—MAY 11

9:00 a.m.—Regency Ballroom, 3rd floor

SESSION T—LIPIDS OF MARINE ORGANISMS. III.

Chairman: **Robert G. Ackman,** Environment Canada, Halifax, Nova Scotia, Canada

Cochairman: **Carter Litchfield,** Rutgers, The State University, New Brunswick, NJ

9:00 **INTRODUCTORY REMARKS**

9:05 147. **DEVELOPMENT OF THE FISH OIL INDUSTRY IN THE UNITED STATES**
M.E. Stansby,* Northwest Fisheries Center, USDC, Seattle, WA

9:45 148. **FILM PRESENTATION: THE STORY OF MENHADEN**
A.P. Bimbo,* Zapata Haynie Corp., Reedville, VA

10:10 149. **A REVIEW OF THE PRODUCTION OF INDUSTRIAL MARINE OILS**
A.P. Bimbo,* Zapata Haynie Corp., Reedville, VA

10:30 150. **WALVIS BAY—FISH FOR THE WORLD**
A.A. Spark,* Fishing Industry Research Institute, Capetown, South Africa

10:50 151. **A SIMPLIFIED PRESENTATION OF FATTY ACID COMPOSITIONS IN FISH OILS AND OTHER MARINE LIPIDS**
G. Lambertsen,* Government Vitamin Institute, Directorate of Fisheries, Bergen, Norway

11:10 152. **THE LANTERN FISH—AN UNEXPLOITED RESOURCE**
A.A. Spark,* Fishing Industry Research Institute, Capetown, South Africa

11:30 153. **REMOVAL OF PESTICIDE RESIDUES FROM MENHADEN OIL**
L.L. Diosady,* Cambrian Processes Ltd., Mississauga, Ontario, Canada

12:00 154. **STEPWISE REMOVAL OF CHLORINATED HYDROCARBONS DURING PROCESSING OF HERRING OIL FOR EDIBLE USE**
R.F. Addison, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, and R.G. Ackman,* Environment Canada, Halifax, Nova Scotia, Canada

WEDNESDAY AFTERNOON—MAY 11

2:00 p.m.—Royal Ballroom A, 2nd floor

SESSION U—AN UPDATE ON PROCESSING AND MARKETING REGULAR FATTY ACIDS

Chairman: **Peter Kalustian,** Peter Kalustian Associates, Boonton, NJ

2:00 155. **FATTY ACID PROCESSING**
R. Wiggins,* HumKo Sheffield Chemical, Memphis, TN

2:15 156. **FATTY ACID SITUATION IN EUROPE**
T.E.A. Arts,* Akzo Chemie GmbH., Germany

2:30 157. **PRESENT AND FUTURE MARKETS FOR NATURAL FATTY ACIDS**
R.M. Hull,* Hull and Co., Bronxville, NY

2:45 158. **EXPANDING MARKETS FOR NATURAL FATTY ACIDS**
Emery Industries, Cincinnati, OH

3:00 159. **ISOSTEARIC ACID**
R. Daniels,* Union Camp Corp., Savannah, GA

3:15 160. **FATTY ACIDS FOR DERIVATIVE USE**
Armak, Chicago, IL

3:45 162. **HYDROGENATION CATALYSTS FOR FATTY ACIDS**
V. Dohrer,* Konigswarter and Ebell, Chemische Fabik GmbH, Germany

4:00 **DISCUSSION**

WEDNESDAY AFTERNOON—MAY 11

2:00—Regency Ballroom, 3rd floor

SESSION V—TRACE METALS IN FATS AND OILS

Chairman: **Timothy L. Mounts,** Northern Regional Research Center, ARS, USDA, Peoria, IL

2:00 163. ATOMIC ABSORPTION SPECTROSCOPY SUBCOMMITTEE: PAST AND PRESENT ACTIVITIES
K.M. Brobst,* A.E. Staley Mfg. Co., Decatur, IL

2:30 164. INFLUENCE OF FLUORESCENT LIGHT AND COPPER ON ANTIOXIDANT AND PROOXIDANT EFFICIENCY IN CERTAIN FOOD ADDITIVES
M.H. Chahine,* Nova Scotia Research Foundation Corp., Dartmouth, Nova Scotia, Canada

3:00 165. FEASIBILITY OF TREATMENT OF STORED CRUDE OILS WITH TERTIARY BUTYLHYDROQUINONE AND OTHER ANTOIXIDANTS. PART II. INFLUENCE OF TRACE METALS AND FREE FATTY ACIDS
M.H. Chahine,* Nova Scotia Research Foundation Corp., Dartmouth, Nova Scotia, Canada

3:30 166. PHOSPHORUS CONTENT OF SOYBEAN OILS
C.D. Evans,* G.R. List, L.T. Black, and T.L. Mounts, Northern Regional Research Center, ARS, USDA, Peoria, IL

WEDNESDAY AFTERNOON—MAY 11

2:00 p.m.—Georgian Ballroom A, 3rd floor

SESSION W—FRYING OILS

Chairman: **Joyce L. Beare-Rogers,** Department of Health and Welfare, Ottawa, Ontario, Canada

2:00 167. METABOLISM AND LIPOGENIC EFFECTS OF THE CYCLIC MONOMERS OF METHYL LINOLENATE IN THE RAT
E.G. Perkins,* University of Illinois, Urbana, IL, and W.T. Iwaoka, University of Washington, Seattle, WA

2:30 168. BIOLOGICAL EFFECTS DUE TO CHANGES IN FATS DURING HEATING
J.C. Alexander,* University of Guelph, Guelph, Ontario, Canada

3:00 169. AVOIDANCE OF UNDESIRABLE PRODUCTS IN HEATED OILS
R. Ohlson,* Karlshamn, Sweden

3:30 170. CHEMICAL REACTIONS INVOLVED IN THE DEEP-FAT FRYING OF FOODS
S.S. Chang,* Rutgers, The State University, New Brunswick, NJ

4:00 171. QUALITY AND HEALTH ASPECTS OF USED FRYING OILS
G. Billek,* and G. Guhr, Unilever, Hamburg. Germany, and W. Sterner, International Bio-Research, Inc., Hannover, Germany

5:00 DISCUSSION

WEDNESDAY AFTERNOON—MAY 11

2:00 p.m.—Regency Foyer, 3rd floor

SESSION X—GANGLIOSIDES AND OTHER GLYCOLIPIDS

Chairman: **Robert M. Burton,** Washington University Medical School, St. Louis, MO

2:00 172. INTRODUCTION: GLYCOLIPID NOMENCLATURE—1977 STYLE
R. Burton,* Washington University Medical School, St. Louis, MO

2:15 173. CRITERIA OF PURITY OF GANGLIOSIDES AND OTHER GLYCOLIPIDS
L.A. Witting, G.C. Walker, and N. Pelick, Supelco, Inc., Bellefonte, PA

2:45 174. GANGLIOSIDES OF THE NERVOUS SYSTEM
R. Ledeen,* Albert Einstein College of Medicine, Bronx, NY

3:30 176. ENZYMES INVOLVED IN GANGLIOSIDE AND GLYCOLIPID METABOLISM
K. Suzuki,

4:00 177. IMMUNOLOGY OF GLYCOSPHINGOLIPIDS
D. Marcus,* Albert Einstein College of Medicine, Bronx, NY 10461

4:30 178. GANGLIOSIDE INVOLVEMENT IN THE STRUCTURE AND FUNCTION OF CELL SURFACE RECEPTORS FOR GLYCOPROTEIN HORMONES, BACTERIAL TOXINS, AND INTERFERON
L.D. Kohn,* National Institutes of Health, Bethesda, MD

5:05 DISCUSSION

THURSDAY MORNING—MAY 12

9:00 a.m.—Royal Ballroom B, 2nd floor

SESSION Z—HIGH MOLECULAR WEIGHT DIBASIC ACIDS

Chairman: **Robert W. Johnson,** Union Camp Corp., Savannah, GA

9:00 179. MECHANISMS OF DIMER ACID FORMATION
N.E. Lawson,* Union Camp Corp., Savannah, GA

9:30 180. STRUCTURE OF DIMER ACIDS
J. White,* General Mills, Minneapolis, MN

10:00 181. DIMER ACID APPLICATIONS
E.C. Leonard,* Humko Sheffield, Memphis, TN

10:30 182. C-19 DIBASIC ACID, PROCESS AND END USES
E.N. Frankel,* Northern Regional Research Center, ARS, USDA, Peoria, IL

11:00 183. C-21 DIBASIC ACID, PROCESS AND END USES
B.F. Ward,* Westvaco, New York, NY

THURSDAY MORNING—MAY 12

8:30 a.m.—Georgian Ballroom A, 3rd floor

SESSION AA—SYMPOSIUM ON SURFACE ACTIVE PHENOMENA

Chairman: **Warner Linfield,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

8:30 183A. ULTIMATE BIODEGRADATION STUDIES OF ALPHA OLEFIN SULFONATES
H. Chung, J.C. Rapean, and L. Kravetz,* Shell Development Co., Houston, TX

9:00 184. POLYMER/SURFACTANT INTERACTIONS
E.D. Goddard* and R.B. Hannan, Union Carbide Corp., Tarrytown, NY

9:30 185. ALCOHOL HOMOLOG DISTRIBUTION EFFECT ON THE VISCOSITY OF THE SODIUM ALKYL SULFATE DERIVATIVE
S.E. McGuire and W.H. Chambless,* Continental Oil Co., Ponca City, OK

10:00 186. PERFORMANCE OF SURFACTANTS IN INTERFACIAL PHENOMENA
M.J. Rosen,* CUNY, Brooklyn College, Brooklyn, NY

10:30 187. EFFECT OF LIME SOAP DISPERSING AGENTS ON THE SOLUTION PROPERTIES OF SOAP
J.K. Weil* and W.M. Linfield, Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

11:00 188. FORMATION AND STABILITY OF MICROEMULSIONS
H.L. Rosano,* The City College of CUNY, New York, NY, W. Gerbacia, Chevron Oil Field Research Co., Perth Amboy, NJ, and J.H. Whittam, Gillette Corp., Boston, MA

11:30 189. EFFECT OF ELECTROLYTES ON POLYOXYETHYLATED NONIONIC SURFACTANTS
H. Schott,* Temple University, Philadelphia, PA, and S.K. Han, Busan National University

THURSDAY MORNING—MAY 12

9:00 a.m.—Regency Ballroom, 3rd floor

SESSION BB—EPA, ITS RELATION TO OIL PROCESSING

Chairman: **Joyce C. Kern,** Fatty Acid Producers' Council, New York, NY

9:00 190. CONTROL OF COOLING TOWER OILS IN EDIBLE OIL REFINERIES
J.F. Bourner,* Capital City Products Co., Columbus, OH

9:30 191. (TITLE NOT AVAILABLE AT PRESS TIME)
R. Shaffer,* Effluent Guidelines Division, Office of Water Programs, EPA, Washington, DC

10:00 192. (TITLE NOT AVAILABLE AT PRESS TIME)
G.N. McDermott,* Procter and Gamble, Cincinnati, OH

10:30 193. **(TITLE NOT AVAILABLE AT PRESS TIME)**
K. Booman,* SDA, New York, NY

11:00 **DISCUSSION**

THURSDAY MORNING—MAY 12

9:00 a.m.—Georgian Ballroom B, 3rd floor

SESSION CC—INDUSTRIAL APPLICATIONS OF FATS AND OILS IN THE CONFECTIONERY INDUSTRY

Chairman: **Vigen K. Babayan,** Stokeley-Van Camp, Indianapolis, IN

9:00 194. **CONFECTIONERY FATS: OVERALL REVIEW OF THE ART**
V.K. Babayan,* Stokeley-Van Camp, Inc., Indianapolis, IN

9:30 195. **FRACTIONATED HARD BUTTERS**
A.E. Thomas III* and A.G. Herzing, Durkee Foods Division, SCM Corp., Strongsville, OH

10:00 196. **FRACTIONATED LAURIC HARD BUTTERS AND THEIR APPLICATION IN CONFECTIONERY COATINGS**
J.R. Brodbeck, Jr.,* Capital City Products, Columbus, OH

10:30 197. **MANUFACTURE OF HARD BUTTERS BY HYDROGENATION AND INTERESTERIFICATION OF OILS AND FATS**
J.G. Marcus and P.S. Puri,* Best Foods Research and Engineering, Union, NJ

11:00 198. **HARD BUTTERS IN ALLIED FOOD USES**

11:30 **DISCUSSION**

THURSDAY MORNING—MAY 12

9:00 a.m.—Regency Foyer, 3rd floor

SESSION DD—GENERAL SESSION: SEED OILS

Chairman: **Glen A. Jacobson,** Campbell Institute for Food Research, Camden, NJ

8:40 201A. **PHYTIC ACID REMOVAL FROM SOYBEANS BY A LIPID PROTEIN CONCENTRATE PROCESS**
J.R. Ford, G.C. Mustakas,* R.D. Schmutz, Northern Regional Research Center, ARS, USDA, Peoria, IL

9:00 202. **CONVERSION OF CHEESE WHEY TO YEAST OIL AND PROTEIN (HONORED STUDENT PRESENTATION)**
N.J. Moon* and E.G. Hammond, Iowa State University, Ames, IA

9:20 203. **PHYTOSTEROL CONTENT OF FOODS**
J.L. Weihrauch,* ARS, USDA, Hyattsville, MD, and J. Gardner, University of Maryland, College Park, MD

9:40 204. **THE EFFECT OF FUNGAL INFECTION UPON FREE FATTY ACID LEVELS OF SAFFLOWER SEED (HONORED STUDENT PRESENTATION)**
T.C. Heaton,* D.S. Mikkelson, P.F. Knowles, and J.E. Ruckman, University of California at Davis, Davis, CA

10:00 205. **FIELD EVALUATION OF EXTRACTION PERFORMANCE**
E.D. Milligan* and D.C. Tandy, EMI Corp., Des Plaines, IL

10:20 206. **EFFECT OF STAGE OF MATURITY ON THE CHEMICAL COMPOSITION OF SUNFLOWERSEED AND ITS RELATIONSHIP TO PHYSIOLOGICAL MATURITY**
J.A. Robertson,* Field Crops Laboratory, ARS, USDA, Athens, GA

10:40 207. **LIPIDS OF DEFATTED SOY FLOURS DURING STORAGE**
S.L. Melton* and R.E. Moyers, University of Tennessee, Knoxville, TN

11:00 208. **SEED FAT FROM Eschscholzia californica, CALIFORNIA POPPY**
O. Levin* and C. Eriksson, Margarinbolaget, Stockholm, Sweden

11:20 209. **HYDROGENATED SUNFLOWERSEED OIL: OXIDATIVE STABILITY AND POLYMER FORMATION ON HEATING**
W.H. Morrison* and J.A. Robertson, Field Crops Laboratory, ARS, USDA, Athens, GA

11:40 210. **NEW NATURAL SOURCES OF ACETOTRIGLYCERIDES**
C.R. Smith, Jr.,* and R.V. Madrigal, Northern Regional Research Center, ARS, USDA, Peoria, IL

POSTER SESSIONS

WEDNESDAY, MAY 11, 9:00–12:00 A.M.
WEDNESDAY, MAY 11, 2:00–5:00 P.M.

All Poster Sessions in Royal Ballroom B, 2nd floor

WEDNESDAY MORNING, MAY 11

9:00 211. **THE EFFECT OF TYPE V HYPERLIPOPROTEINEMIA ON THE STRUCTURES OF TRIACYLGLYCEROLS, PHOSPHATIDYL CHOLINES, AND CHOLESTEROL ESTERS IN EACH OF THE LIPOPROTEIN CLASSES**
K.E. McMahon,* S.A. Gerrior,* M.M. Hagerty,* and R.G. Jensen,* University of Connecticut, Storrs, CT

9:45 212. **INFLUENCE OF α-TOCOPHEROL ON FUNGAL LIPIDS DURING AGING**
M. Sbasching* and R.C. Jack, St. John's University, Jamaica, NY

10:30 213. **THE CRYSTAL STRUCTURES AND STABILITIES OF THE β-2 AND β-3 MODIFICATIONS OF SATURATED TRIGLYCERIDES**
T.C. van Soest* and S. de Jong, Unilever, Vlaardingen, The Netherlands

11:15 214. **THE CRYSTAL STRUCTURES OF POP, POS, OSO, AND HOMOLOGUES IN THE β-3 FORM. THE PHASE V → PHASE VI TRANSFORMATION OF COCOA BUTTER**
T.C. van Soest* and S. de Jong, Unilever, Vlaardingen, The Netherlands

WEDNESDAY AFTERNOON, MAY 11

2:00 215. **TRAPPING AND IDENTIFICATION OF VOLATILES PRODUCED DURING THERMAL OXIDATION OF SOYBEAN OIL**
T. Riisom,* Grindstedvaerket A/S, Denmark

2:45 216. **EFFECTS OF ETHANOL ON LIPID PRODUCTION IN A FUNGUS**
M.L. Dalpiaz,* A.J. Chenet, R.C. Jack, St. John's University, Jamaica, NY

3:30 217. **CHOLESTEROL ESTER METABOLISM IN THE ADRENAL GLAND**
D.M. Creech,* A.Y. Sun, and G.Y. Sun, University of Missouri, Columbia, MO

4:15 218. **GLYCOLIPIDS OF HUMAN GASTRIC SECRETION**
A. Slomiany,* B.L. Slomiany, and G.B.J. Glass, New York Medical College, New York, NY

TUESDAY AFTERNOON—MAY 10

2:00 p.m.—Royal Ballroom B, 2nd floor

SESSION GG—USE OF FATS IN COSMETICS

Chairman: **Eric Jungermann,** Helene Curtis, Chicago, IL

2:00 220. **FATS AND OILS, THE HISTORICAL COSMETICS**
M. de Navarre,* Vanda Beauty, Orlando, FL

2:30 221. **USE OF FATTY ACID DERIVATIVES IN COSMETICS AND TOILETRIES**
D. Johnson,* Armak, Chicago, IL

3:00 222. **OILY COMPONENTS IN COSMETICS FROM A EUROPEAN VIEW**
H. Kroke,* Henkel KGaA, Dusseldorf, Germany

3:30 223. **LANOLIN AND ITS DERIVATIVES**
M.L. Schlossman,* Malmstrom Chemicals, Linden, NJ

4:00 224. **PHYTOLIPIDS IN PERSONAL CARE PRODUCTS**
L. Lundmark,* General Mills, Minneapolis, MN

4:30 225. **CASTOR OIL—A NATURAL COSMETIC INGREDIENT**
K. Fozdar,* F. Duneczky, and F.C. Naughton, NL Industries, Inc., Hightstown, NJ

WEDNESDAY AFTERNOON—MAY 11

2:00 p.m.—Georgian Ballroom B, 3rd floor

SESSION Y—OIL PROCESSING

Chairman: **Frank Passalaqua,** Industrial Filter and Pump, Cicero, IL 60650

2:00 226. **EMI EDIBLE OIL DEODORIZING SYSTEMS**
A.M. Gavin,* EMI Corp., Des Plaines, IL

2:30 227. **OLD AND NEW IN WINTERIZING**
G.M. Neumunz* and R. Nasser, Neumunz Inc., Leonia, NJ

3:00 228. **CAMPRO**
R.S. Jickling,* Campro, Cambrian Processes Ltd., Mississauga, Ontario, Canada

ABSTRACTS OF PAPERS

1

AN UPDATE ON FILTRATION IN THE EDIBLE OIL INDUSTRY. FRANK PASSALAQUA, Industrial Filter and Pump Manufacturing Company, 200 N. Delmont, Conroe, TX 77301.

This presentation discusses current innovations in the use of filters and filter systems, in all processes of vegetable oil, with emphasis on equipment design, leaning towards a minimum of maintanance and operating costs.

1A

CONTINUOUS SOLVENT FRACTIONATION. MARIO BERNARDINI, c/o C.M.B. Costruzioni Meccaniche Bernardini, Via della Petronella 2, 00040 Pomezia (Rome), Italy.

Fractionation of fats whether of animal or vegetable origin has become in recent years of growing importance to the refiners as it enables them to obtain a wide range of products which can be used in many segments of the food industry. The fractionation process using hexane as solvent offers enormous advantages derived from its high flexibility. In fact by varying the operating conditions of temperature and oil-solvent ratio it is possible to obtain a large variety of products with different characteristics and high yields. This is generally not possible with the conventional fractionating processes. In particular this paper provides a description of the operation of the plant, of the main characteristics of its components, and of the results which can be obtained when fractionating partially hydrogenated soybean oil. In addition the results obtained when processing cottonseed oil, palm oil, palm kernel oil, fish and other oils are also given.

2

HYDROGENATION CATALYSTS—YESTERDAY, TODAY, TOMORROW. SALVATORE N. MILAZZO, Activated Metals and Chemicals, Inc., PO Box 32, Sevierville, TN 37862.

The need for specific performing fats and oils has led to new hydrogenation techniques and prompted the developments of new, superior hydrogenation catalysts. Our experience in the edible oil, fatty acid, and catalyst industries encompasses some thirty years of research development, processing, manufacturing, and close association with all hydrogenators. Using the title of this paper, we will detail operating procedures, with emphasis on the specific catalyst to realize the required products. Each area will be discussed with particular emphasis on where we have been and where we expect to be in the near and distant future. How important are the catalysts? Why is it necessary to use specific products to realize the proper end-use characteristics? What does it take to produce today's exotic hydrogenated fats and oils?

3

ELECTRICAL SEPARATION OF SOLID MATTER FROM FATS AND OILS. O. WAGNER, T.D. MCLAREN, Petrolite Corporation, Petreco Division, PO Box 2546, Houston, TX 77001.

The patented Petreco® Electro-Filter™ Separator represents some fifteen years of development effort with the last two years being devoted to laboratory and field pilot work associated with the domestic fats and oils industry. A commercial unit separating nickel catalyst from hydrogenated vegetable oil is demonstrating product quality and operational improvements over conventional filters. Data from this commercial unit are presented. Development of other applications continues and is reported. The system design incorporates an electrode assembly embedded in a special media contained in a pressure vessel. Electricity is applied during the separation cycle and particles are retained within the energized system. When the media has reached the designed throughput capacity, the separator is regenerated by a simple backwash procedure. A small demonstration unit is to be displayed.

4

DIRECT SOLVENT EXTRACTION OF HIGH OIL CONTENT SEEDS. MARIO BERNARDINI, c/o C.M.B. Costruzioni Meccaniche Bernardini, Via della Petronella 2, 00040 Pomezia (Rome), Italy.

In this paper a description is given of some types of extractors operating according to the percolation and immersion principles and used for the removal of oil from the various oil-bearing materials. The combined use of the percolation extractor and of a special immersion extractor has made it possible to design a plant for the direct extraction of high oil content seeds with no need for prepressing equipment. Many plants of this type are presently running and the yields and consumption figures recorded during the processing of various seeds such as copra, groundnut, sunflower, safflower, palm kernel, and sesame are reported. A comparative table showing the processing costs and consumption figures in the case of prepressing followed by solvent extraction and direct solvent extraction is also illustrated.

5

MANAGEMENT OF AN EDIBLE OIL BUSINESS. RICHARD E. HELLAND, Capital City Products, Columbus, OH.

Abstract not available at press time.

6

CHANGING TRENDS IN CONSUMER MARGARINES. FELIX J. MASSIELLO, J. H. Filbert, Inc., 3701 Southwestern Blvd., Baltimore, MD 21229.

The advent of soft margarine opened up new vistas in types of margarine and new forms of packaging, creating new consumer demand for convenience and variety. The margarine market today is divided into many small segments to cater to the individual needs of the consumer. Today in addition to the usual stick and solid pound margarines, the consumer can buy a diet margarine, a high polyunsaturated margarine, a liquid margarine, corn oil margarine, whipped margarine, and lower fat spreads. These margarines can be purchased in all types of convenience and reusable containers such as cups, drinking mugs and tumblers, and bowls. The future could bring expansion of the low fat spreads and also further segmentation of margarine types, while catering to small but significant segments of the population.

7

COMMERCIAL AND POTENTIAL UTILIZATION OF SOYBEAN LIPOXYGENASE. E.A. EMKEN and E.N. FRANKEL, Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604.

The high specificity and activity of lipoxygenase (EC 1.13.1.13) has not been widely exploited in commercial applications. One application of substrate specificity is exemplified by the Canadian Food and Drug Official Method FA 59 for determining unisomerized linoleic acid in hydrogenated fats. Bleaching of wheat flour dough is the only example of commercial utilization of lipoxygenase. The decolorization of carotenes and other pigments is the result of "secondary" or "coupled" oxidation. These reactions occur between the pigments and the hydroperoxy-conjugated octadecadienoic acids which are formed by lipoxygenase oxidation of linoleic acid. Lipoxygenase oxidation of linoleic acid on an industrial scale is an attractive idea for conversion of a renewable resource into a valuable chemical intermediate. Hydroxy-conjugated octadecadienoic acids (HCD) have been prepared by oxidation of a 10% soybean soapstock solution with an aqueous soy flour extract followed by reduction of the hydroperoxide. High yields and a 20-min reaction time are features of this procedure. These laboratory-scale experiments indicate that the process can produce hydroxy-conjugated octadecadienoic acids at an estimated cost of 41 cents per pound if 15-cents-per-pound soapstock is used. The combined hydroxy, conjugated diene, and fatty acid groups in HCD give it the potential of being a versatile chemical intermediate. HCD is readily converted to hydroxystearate or conjugated triene and can compete directly with tung oil acids or hydrogenated castor oil acids. Other reactions can be visualized based on functional group modification. Some obvious examples of possible reactions are (a) esterification with polyhydric alcohols, (b) Diels-Alder condensations to form cyclic fatty acids, (c) partial hydrogenation with selective catalysts, and (d) dimerization or polymerization. Most of these reactions would yield products with potential application in the formulation of coatings, lubricants, emulsifiers, and plasticizers.

8

THE PREPARATION OF FATTY CHEMICALS WITH LIPOLYTIC ENZYMES. ROBERT G. JENSEN, MARGOT HAGERTY, and KATHLEEN E. MCMAHON, Department of Nutritional Sciences, University of Connecticut, Storrs, CT 06268.

Lipolytic enzymes, glycerol ester hydrolases and phospholipases, have been used to determine the structure of acylglycerols and phosphoglycerides by taking advantage of their specificities. These include both positional and group specificities. However, these enzymes have not been utilized to the extent that they should in the preparation of fatty chemicals. Small quantities of compounds that are difficult to synthesize, such as 2-monoacylglycerols and lysophosphoglycerides, can be obtained quickly and reliably with the aid of lipolytic enzymes. These and other similar enzymatic reactions will be reviewed in this discussion.

9

MICROBIOLOGICAL TRANSFORMATIONS OF PROSTAGLANDINS. CHARLES J. SIH, School of Pharmacy, 425 N. Charter St., University of Wisconsin, Madison, WI 53706.

The prostaglandins are a family of compounds derived biosynthetically from polyunsaturated fatty acid precursors such as all *cis*-8,11,14-eicosatrienoic or 5,8,11,14-eicosatetraenoic acids. These substances are widely distributed in the body and elicit profound diverse physiological effects even at nanomolar concentrations in the cardiovascular, nervous, reproductive, renal, and gastric systems. Because several classes of microbial enzymes possess broad substrate specificity yet catalyze reactions with high degrees of stereospecificity, they have been successfully employed in several total syntheses of prostaglandins. Microbial esterases have been used for the resolution of enantiomeric intermediates and alcohol dehydrogenases have been used for the generation of key chiral centers. The action of microbial enzymes on the prostanoic acid skeleton has been amply investigated. Several of these transformation products may have therapeutic value in that they exhibit a narrower spectrum of physiological activities than their parent compounds. The reactions include: (a) oxidation-reduction of carbonyl functions at C-9 and C-15; (b) hydroxylations at C-18, C-19 and C-20 positions; (c) reductions of double bonds at C-10(11) and C-13(14); (d) hydrolyses of ester groupings; (e) oxidation of primary alcohols; (f) oxidation of the fatty acid chain via β-oxidation.

10

INTERMEDIATES FROM THE MICROBIAL OXIDATION OF ALIPHATIC HYDROCARBONS. A.J. MARKOVETZ, Department of Microbiology, University of Iowa, Iowa City, IA 52242.

Oxidation of aliphatic saturated and unsaturated hydrocarbons by bacteria, yeasts, and fungi leads to the production of a variety of intermediates, e.g., mono- and dicarboxylic acids, primary alcohols, isomeric alcohols and their corresponding ketones, diols, epoxides, and hydroxy acids. Further degradation of isomeric ketones in two species of *Pseudomonas* occurs by a flavoprotein monooxygenase leading to the formation of ester intermediates. In the case of 2-tridecanone → undecyl acetate, the esterase active on the acetate ester also has been characterized. Oxidation of pristane gives rise to several branched chain intermediates of varying carbon length. Products from other branched chain hydrocarbons are also presented. The oxidation of hydrocarbons that are not growth substrates but are nonetheless oxidized by microorganisms will be reviewed.

11

^{13}C NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY, AN IMPORTANT NEW TOOL FOR THE LIPID CHEMIST. PHILIP E. PFEFFER, Eastern Regional Research Center, ARS, USDA, 600 East Mermaid Lane, Philadelphia, PA 19118.

This presentation will describe the basic principles of ^{13}C

nuclear magnetic resonance (NMR) spectroscopy and outline its many applications in the field of lipid chemistry. Over recent years, no other technique has grown to such importance as that of NMR spectroscopy. It is used in all branches of science where precise structural determination is required or where the nature of interactions or reactions in solution is being studied. It is no longer the technique of the specialist; it is used, and the results are interpreted, by chemists from all disciplines. Examination of specific physical phenomena such as relaxation rates has allowed for a more complete description of both molecular motion and molecular interactions in solution. Rapid pulsed Fourier-transform techniques have added a new dimension to NMR methodology, making nuclei such as natural abundance (1.1%) ^{13}C readily observable. In turn, ^{13}C spectroscopy has opened new doors to exploring and elucidating the structures of complex lipids.

12

^{13}C SPIN RELAXATION AS A PROBE OF LIPID BILAYER STRUCTURE. J.H. PRESTEGARD, Chemistry Department, Yale University, 225 Prospect St., New Haven, CT 06520.

Spin relaxation is an often neglected nuclear magnetic resonance (NMR) parameter easily attainable from pulse observations of coarse lipid dispersions or other lipid bilayer systems which serve as models for biological membranes. Interpretation of both spin-spin and spin-lattice relaxation for ^{13}C spectra in terms of detailed molecular motions is possible because of the dominance of interactions of directly bonded protons with carbons of interest. Interpretation for the hydrocarbon portions of lipid bilayers does however require the use of a model which accounts both for localized crankshaft motions as well as for more disrupting chain isomerizations. A convenient model consistent with available proton and carbon relaxation data will be presented, and examples from systems perturbed by both steroids and proteins will be discussed.

13

APPLICATIONS OF ^{13}C NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY TO THE STRUCTURAL DETERMINATION OF LONG CHAIN COMPOUNDS. A.P. TULLOCH, Prairie Regional Laboratory, National Research Council of Canada, Saskatoon, Sask. S7N 0W9, Canada.

Many naturally occurring long chain compounds which contain several hydroxy or oxo groups are found as mixtures of positional isomers. The possibility of determining the composition of such mixtures by ^{13}C NMR spectroscopy has now been investigated. Signals in the ^{13}C NMR spectra of isomeric hydroxy, acetoxy, and oxo esters have been assigned from spectra of specifically deuterated isomers so that the degree of interaction between functional groups can be estimated. Application of the method to mixtures of C_{16} plant cutin acids and to mixtures of oxygenated β-diketones from plant waxes will be discussed.

14

^{13}C NUCLEAR MAGNETIC RESONANCE SPECTRA OF UNSATURATED FATTY ACID METHYL ESTERS. J. BUS, T. SIES, and M.S.F. LIE KEN JIE, Unilever, Vlaardingen, The Netherlands.

The carbon magnetic resonance spectra of 102 fatty acid methyl esters with *cis* and *trans* double bonds and triple bonds at various positions and in many different combinations have been investigated. These include methyl alkenoates, alkadienoates, -trienoates, -tetraenoates, alkynoates, alkadiynoates, an alkatriynoate, alkenynoates, and an alkenediynoate. We have developed a comprehensive set of (additive) parameters, describing the chemical shift changes for the various carbon atoms in the molecules, caused by double bonds, triple bonds, chain terminal methyl groups and carbomethoxy groups. The influence of the carbomethoxy group on double and triple bond carbon atoms in the fatty acid chain depends strongly on the positions of these bonds. However, for a given position the effect is constant even if one or more other double or triple bonds are present. With the aid of the evaluated chemical shift parameters, complete assignments are possible and spectra of many types of unsaturated esters can be predicted with high accuracy (± 0.1 ppm).

15

APPLICATION OF PULSED NUCLEAR MAGNETIC RESONANCE FOR DETERMINING THE SOLIDS CONTENT OF FATS AND SHORTENINGS. BRYAN L. MADISON and RAYMOND C. HILL, Procter & Gamble Co., Winton Hill Technical Center, 6071 Center Hill Rd., Cincinnati, OH 45224.

The determination of the solid fat content plays an important role in the fat industry as a good indicator of the plastic range possibilities of a fat or fat blend. A brief review of the technical basis for measuring the solid fat content by dilatometry and nuclear magnetic resonance (NMR) spectroscopy is discussed. A rapid and accurate method using pulsed NMR is presented for determining the percentage of solids in commercial shortenings and hydrogenated oils conditioned at selected temperatures. Results indicate that this method provides more reliable information on the solids content of fatty materials than does the empirically based dilatometer method and is superior to the wide-line NMR technique. The results are obtained using a Praxis Model SFC-900 Analyzer equipped with six 10 mm sample probes in combination with a precise variable-temperature accessory system. With this method, a large number of samples can be measured in a reasonable amount of time. With the improvements for faster and more exact temperature conditioning of the samples, better stability and easier handling for routine conditions are accomplished. A single temperature result can be made in less than 1 hr and typical five-temperature results can be obtained in 1.5 hr. A standard deviation of 0.27% solids, unaffected by parameter interactions, indicates good reliability and reproducibility. A comparison of pulsed NMR and dilatometry for measuring solids content is also presented.

16

THE PRAXIS SFC-900, AN INTEGRATED APPROACH TO SOLID FAT CONTENT DETERMINATION. G.A. PERSYN, The Praxis Corp., 5420 Jackwood, San Antonio, TX 78238.

Solid fat content determination requires precise control of temperature and tempering conditions as well as of the analytical method used. The PRAXIS SFC-900 Analyzer combines these three functions into a self-contained integrated system. Refrigeration and heating units regulated by precision proportional controllers are used to establish the temperature for seven probes. Each probe has a thermistor thermometer readout and can process 20 samples at a time. Three tempering timing intervals can be preset in 5 min increments up to 45 min. The measurement of the liquid fat content by the pulsed nuclear magnetic resonance technique allows calculation of the solid fat content. Six of the probes contain magnets and sample coils while the seventh probe is used only for tempering. This instrumental combination of temperature, tempering, and the analytical technique utilizes the best features of dilatometry while not requiring special glassware, toxic reagents, and water baths with their space, maintenance, and thermal load problems. Furthermore, the operators are more easily trained to take routine data. Details of the above mentioned features and experimental operating data will be presented. Other data will be presented in the preceding paper by Madison and Hill.

17

QUANTITATIVE DETERMINATION BY ^{13}C NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY OF *cis/trans* RATIOS OF ALLYLIC HYDROPEROXIDES AND HYDROXIDES IN OXIDIZED UNSATURATED FATTY ACID ESTERS. B.C.L. WEEDON, R.F. GARWOOD, B.P.S. KHAMBAY, and G.E. HAWKES, University of London, London, England, and E.N. FRANKEL, Northern Regional Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604.

^{13}C nuclear magnetic resonance (NMR) spectroscopy has been applied to determine quantitatively the *cis/trans* ratio of allylic hydroperoxides and hydroxides from oxidized methyl oleate (after concentration of the autoxidation products). The ^{13}C NMR signals of the allylic carbons bearing oxygen appear at characteristic positions (*cis* C-OH δ 67.5; *trans* C-OH δ 73.1; *cis* C-OOH δ 81.1; *trans* C-OOH δ 86.9). Comparison of the peak heights of the substituted allylic ^{13}C resonances of both hydroperoxides and hydroxides gives a quantitative value of *cis/trans* ratios to within ca. + 2% accuracy (checked by employing known mixtures of allylic hydroxy esters). The method is nondestructive and unlike conventional methods, does not require isolation of the hydroperoxides and hydroxides from crude oxidation products. The effects of temperature on crude mixtures from autoxidized methyl oleate are being studied. An extension of this work to autoxidized methyl linoleate and methyl linolenate will be presented.

18

ODOR CONTROL IN EDIBLE OIL PROCESSING. W.J. GILBERT, JR., Division Manager Air Pollution Control Equipment, Croll Reynolds Co., Westfield, NJ.

Processing of edible oil under vacuum results in a very small gas discharge flow. Whether the discharge is from a mechanical vacuum pump or steam jet ejector, it often contains small quantities of long chain fatty acids. These small gas streams have created an odor nuisance. Several techniques have been applied to this problem. This paper will discuss the various techniques and their success.

19

FAT AND OIL RECOVERY FROM PACKING HOUSE AND RENDERING OPERATIONS WASTEWATER BY ELECTROCOAGULATION. E.R. RAMIREZ and D.L. JOHNSON, Swift Environmental Systems, Oak Brook, IL 60521.

A new electrolytic technology is described in removing suspended solids as well as fats and oil from packinghouse and rendering operations wastewater. The process also removes soluble blood, as well as heavy metals. Rendering of the skimmings obtained from the electrolytic coagulation process will be discussed. Cost of treating wastewater (¢/1000 gal) and value of the fats and oils received from the wastewater will be documented. Capital equipment costs and operating costs of electrocoagulation will be discussed. Advantages of the electrolytic technique as compared to dissolved air flotation will be reviewed. Basically, the electrolytic process removes suspended material, and soluble blood as well as fats and oils from the wastewater stream. Efficiency in removing these materials from wastewater will be documented.

20

FAT AND OIL RECOVERY FROM MEAT PROCESSING WASTEWATERS BY ELECTROCOAGULATION. E.R. RAMIREZ and O.A. CLEMENS, Swift Environmental Systems, Oak Brook, IL 60521.

A new technology based on electrocoagulation is used to purify meat processing wastewater and also to recover better than 90% of the fats and oils in the wastewater. The electrolytic process is also especially effective in removing proteins and other suspended materials from the wastewater. The meat processing plant in this case history is located in a suburb of Chicago. It processes ca. 100,000 lb of meat consisting of hog and beef cuts. The plant employs ca. 150 gal/min of water. Electrolytic power consumption in recovering the fat and oil values from the wastewater lie in the range of ½ to 1 kilowatt hr/1000 gal processed. Treatment parameters and percent reduction in pollutant load of the wastewater are documented. Size of tank, the use of chemicals, and principle of operation of electrocoagulation will be discussed.

21

CARVER-GREENFIELD PROCESS FOR INDUSTRIAL WASTES. CHARLES GREENFIELD, Dehydro-Tech Corp., East Hanover, NJ 07936.

The process utilizes low energy cost multi-effect evaporators to produce a dehydrated product using an oil carrier for transport, heat transfer, and antifouling agent for the metal heat transfer surfaces. The dehydrated suspension of solids in oil is centrifuged to produce a product containing some oil. By proper selection of the oil medium, such as a petroleum light oil, all of the oil used as the oil carrier can be removed and, in fact, oil can be extracted from the raw material if present to recover oils as credit for the process such as fuel oil. The dehydrated product can be produced essentially oil free if desired and can be marketed as a fuel, animal feed, or food product. Pyrolysis of the dry solids is especially advantageous to maximize fuel gas and electricity production with minimal air pollution problems. Case histories of several industrial installations such as pharmaceutical wastes, dog food manufacturing wastes, and milk whey food production will be described.

22

COALESCERS. EDWARD HERDENREICH, Hyde Products, West Lake, OH.

Abstract not available at press time.

22A

MEASUREMENT OF RATES OF FATTY ACID SYNTHESIS BY GAS CHROMATOGRAPHY AND MASS SPECTROMETRY. GEORGE M. PATTON and JOHN M. LOWENSTEIN, Biochemistry Department, Brandeis University, Waltham, MA 02154.

Livers of rats are perfused with perfusate containing ^2H_2O and ^3H_2O. The livers are extracted with chloroform-methanol (2:1), and the fatty acids in the extract are isolated and methylated. The resulting mixture is chromatographed on an open tubular column (0.25 mm × 50 m) coated with EGSS-X. The newly synthesized fatty acids which contain deuterium derived from the water separate from the pre-existing unlabeled fatty acids. Thus the rates of synthesis of the individual fatty acids can be determined directly from the areas under the peaks. Individual fatty acid methyl esters are also separated on a short column which does not separate the deuterated from the nondeuterated species. Peaks containing individual fatty acids are collected and analyzed by mass spectrometry. The mole fraction of each fatty acid synthesized de novo by the liver as determined by mass spectrometry agrees closely with that determined by high resolution gas chromatography. The degree of separation of the deuterated from the nondeuterated fatty acids is proportional to the number of deuterium atoms in the newly synthesized fatty acids. The current practical limits of the method necessitate the use of perfusion fluids containing 30–50% ^2H_2O. The two methods agree closely with rates obtained by determining ^3H_2O incorporation into fatty acids by liquid scintillation counting.

23

INTERRELATED EFFECTS OF FOOD LIPIDS ON STEROID METABOLISM. BARBARA C. O'BRIEN, CHARLES L. SKUTCHES, GLEN R. HENDERSON, and RAYMOND REISER, Department of Biochemistry and Biophysics, Texas A&M University, College Station, TX 77843.

Semipurified diets containing either: (a) 15% sterol-free lard; (b) 15% sterol-free safflower oil; (c and d) diets a and b with 0.5% cholesterol; (e and f) diets c and d with 0.25% mixed soy sterols; and (g and h) diets c and d with 0.5% soy sterols, were fed to female BHE rats for 10 wk. Males were fed all diets except f and h. The diet fats alone were found to have no different effect on the serum cholesterol, but serum triglycerides were significantly lower when the safflower oil was fed. Diet fats had little effect on liver cholesterol, but ingestion of lard resulted in higher liver triglycerides in the female than when safflower oil was consumed. In the female the addition of cholesterol to the sterol-free lard diet increased serum cholesterol from about 90 mg/100 ml to about 500 mg/ml. Its addition to the sterol-free safflower oil diet increased serum cholesterol in that sex to about 350 mg/100 ml. In the male, cholesterol in the two fats increased serum cholesterol from about 120 mg/100 ml to 200 mg/100 ml and 150 mg/100 ml, respectively. Liver cholesterol increased more than 15-fold when either sex was fed cholesterol with either fat. Liver triglycerides were little affected by diet cholesterol in the female but were increased fivefold in the male. One-half percent plant sterols in the cholesterol-containing diets mitigated the effect of diet cholesterol on serum cholesterol. The plant sterols, on the other hand, increased serum triglycerides pronouncedly, especially in the males, but had virtually no effect on liver triglycerides. When cholesterol was added to the diet fats, cholesterol 7α-hydroxylase increased, the response being greater in the female. The addition of plant sterols attenuated the effect of cholesterol on the enzyme. Diet cholesterol caused a large increase in fecal neutral sterols and bile acids, while plant sterols stimulated excretion of neutral sterols and reduced the level of fecal bile acids. The total and component bile acid quantities and distribution were dependent upon both diet fat and sex.

24

EFFECTS OF ETHANOL INGESTION AND DIETARY FAT LEVELS ON MITOCHONDRIAL LIPIDS IN MALE AND FEMALE RATS. (HONORED STUDENT PRESENTATION). JOHN A. THOMPSON and RONALD C. REITZ, Division of Biochemistry, University of Nevada, Reno, NV 89557.

The effects of sex, dietary fat levels, and ethanol ingestion on rat liver mitochondria (RLM) lipids in relation to choline oxidation have been studied. The animals were fed a liquid diet containing either 4.6% or 34.2% of total calories as corn oil. The ethanol was substituted isocalorically for carbohydrate and amounted to 36% of total calories. The animals were maintained for about 45 days on each of the diets. The total as well as individual concentrations of fatty acids, phospholipids, and neutral lipids were determined in all eight groups of animals. Ethanol ingestion resulted in about a 12% increase in the total phospholipid concentration in female RLM fed either the high- or low-fat diet. With the high-fat diet in male RLM, there was a 17% increase in the total phospholipid concentration as a result of ethanol ingestion. However, with the low-fat diet, ethanol ingestion resulted in a 6% decrease in the total phospholipids of the male RLM. The changes in the phospholipid concentrations in all groups of animals could be accounted for almost entirely by changes in the phosphatidyl choline (PC) fraction. A comparison of the PC concentrations with choline oxidase rates showed an inverse relationship. In the high-fat males and in both the low-fat and high-fat females, ethanol had no effect on the rates of choline oxidation. Consequently, the 23% increase in PC concencentration in these three groups of animals was due to an effect of ethanol ingestion on PC synthesis. However, since choline oxidation was increased 52% by ethanol in the low-fat males, the decrease (18%) in PC in these animals was due to the effects of ethanol ingestion on choline metabolism. These results emphasize the importance of dietary levels of fat as well as sex in the study of liver mitochondria structure and function in relation to ethanol metabolism.

25

STIMULATION OF LIPID ABSORPTION IN YOUNG RATS BY CHOLESTEROL: EARLY TIME CHANGES. JOEL BITMAN, JOAN R. WEYANT, DAVID L. WOOD, and T. RANDALL WRENN, Nutrient Utilization Laboratory, Animal Physiology & Genetics Institute, Bldg. 161, BARC-East, Beltsville, MD 20705.

Previous studies in our laboratory have demonstrated that cholesterol stimulates lipid absorption in rabbits, inducing large increases in plasma and tissue cholesterol and lipids. We have examined the effects of cholesterol feeding upon lipid absorption in rats, a rodent species which usually does not respond to cholesterol feeding with lipemia. Four groups of weanling rats were fed a chow diet (0), chow plus 1% cholesterol (C), chow plus 10% corn oil (F), or chow plus 1% cholesterol plus 10% corn oil (CF) for 1, 2, 4, and 8 days to determine the early sequence of changes in liver and plasma cholesterol and lipids. As expected, plasma cholesterol and lipids did not change, but large alterations were observed in several liver components. Liver weight did not change during this short experimental period but liver lipid content increased over control levels about 1% in C, 1.5% in F and 4% in CF rats, demonstrating a synergistic effect of cholesterol and fat. Liver water content declined, exhibiting an inverse relationship to lipid. Within 4 days, liver cholesterol increased 50% in F, 100% in C, and 350% in CF rats, again indicating a synergistic effect of C and F. Eighty-five percent of the increase in liver cholesterol was in the form of esterified cholesterol. Liver glycogen exhibited a decrease which appeared to be inversely related to the increase in liver lipid (Glycogen: 0, C, F, CF being 3.96, 3.47, 1.97, and 2.28 g/100 gWW respectively). Our data indicated that while weanling rats maintain normal plasma cholesterol and lipid concentrations in response to cholesterol feeding, tissue distribution is markedly changed in this rapid growth period. Liver esterified cholesterol and lipid accumulate while glycogen and water decline. These changes in liver cholesterol distribution may represent a major mechanism for maintaining extra-hepatic cholesterol homeostasis.

26

OCCURRENCE OF 2,3-DIACYL-1-ALKYLGLYCEROLS IN THE CUTANEOUS LIPIDS OF THE RHINO MOUSE. MAHENDRA K. LOGANI, DAVID B. NHARI, and RONALD E. DAVIES, Skin and Cancer Hospital, Temple University Health Sciences Center, Philadelphia, PA 19140.

Diacyl-1-alkylglycerols have been reported to occur in various animal tissues. However, to our knowledge, there is no report of their occurrence in skin lipids. Cutaneous lipids from the rhino mutant mouse, on repeated fractionation by thin layer chromatography, afforded diacyl-1-alkylglycerols in 2.7% yield. These were separated into acidic and neutral portions after alkaline hydrolysis. The fatty acids showed a wide range (C_{12}–C_{38}) with surprisingly high proportion of long chain lengths; the principal peaks corresponded to C_{18}, C_{24}, C_{22}, C_{32}, and C_{20}. Characterization of glyceryl ether lipid by spectroscopic and chemical methods will be discussed.

27

LIPOTROPIC EFFECTS OF INOSITOL AND CHOLINE IN THE RAT. D.B. ANDERSEN and B.J. HOLUB, Department of Nutrition, University of Guelph, Guelph, Ontario N1G 2W1, Canada.

Groups of male weanling rats of the Wistar strain were fed a basal diet containing, as a percent by weight, vitamin-free casein, 20; cellulose, 5; salt mixture, 4; vitamin mixture, 1.0; glucose monohydrate, 59.0–59.5; fat (tallow:corn oil 9:1), 10; and varying amounts of added inositol (0–0.5) or choline dihydrogen citrate (0–0.176). After 7 days of feeding the experimental diets, the rats were sacrificed and the concentration and fatty acid composition of liver triglycerides were determined by gas liquid chromatography following thin layer chromatography. The highest level of liver triglycerides was found in the group lacking inositol and choline. A reduction in triglyceride levels was observed when either choline dihydrogen citrate or inositol was added to the basal diet. Minimal triglyceride levels were obtained when choline dihydrogen citrate was added above 208 mg/kg (calculated as free choline) or when inositol was added above 750 mg/kg. There were no significant differences in fatty acid compositions of triglycerides among the groups. The data further suggest that, on a weight basis, free choline is more efficient than inositol in preventing triglyceride accumulation in rat liver. The relationship of dietary inositol and choline to other dietary factors will also be discussed. (This research was supported by the NRC of Canada.)

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STUDIES ON THE UPTAKE OF BILE ACIDS BY THE ISOLATED PERFUSED RAT LIVER. M.M. FISHER, B.R. NAGY, and I.M. YOUSEF, Medical Sciences Building, Room 7258, University of Toronto, Toronto, Ontario, Canada M5S 1A8.

There have been few studies on the hepatic uptake of bile acids and the molecular mechanisms involved in this process have not been defined. Using the isolated perfused rat liver we have studied the kinetics involved in the hepatic uptake of various bile acids. The hepatic uptake of cholic acid (CA) and deoxycholic acid (DOCA) was found to be significantly slower than that of chenodeoxycholic acid (CDCA) and lithocholic acid (LCA) in both male and female rats. Conjugated CA was taken up by the liver significantly more efficiently than unconjugated CA. The isolated perfused liver of the male rat took up LCA and CDCA more rapidly than did that of the female rat but there were no significant sex differences involved in the uptake of CA and DOCA. The liver of the male rat took up conjugated CA more quickly than did that of the female rat. The effect of the size of the bile acid load presented to the liver was studied in the case of CDCA. The rate of hepatic uptake increased linearly with increasing perfusion medium concentrations of CDCA up to 0.6 mM. These studies indicate that the uptake of bile acids by the liver is a complex process influenced by the physicochemical properties of the bile acid, by the load of the bile acid presented to the liver, and by the sex of the animal. (Supported by the Medical Research Council of Canada, MA-3170, and the Canadian Hepatic Foundation.)

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A MODEL FOR STUDYING LECITHIN:CHOLESTEROL ACYLTRANSFERASE REACTION: IN VITRO CHOLESTEROL ESTERIFICATION IN PIG GRAAFIAN FOLLICULAR FLUID. JEFFREY K. YAO, STEVE C.S. CHANG, ROBERT J. RYAN, and PETER JAMES DYCK, Mayo Clinic, Rochester, MN 55901.

Investigation of the mechanisms of lecithin:cholesterol acyltransferase (LCAT) reaction have been limited to the study of plasma or serum. The fluid of ovarian follicles is thought

to be secreted from thecal blood vessels and percolated through a limiting membrane. The lipoproteins entering the follicles are filtered through a so-called "blood-follicular barrier" contain only high density lipoproteins (HDLs). In pig Graafian follicular fluid (PGFF), over 80% of cholesterol is esterified. It is known that the LCAT reaction takes place primarily at HDLs. The possibility that PGFF itself, like plasma, has the ability to esterify cholesterol was explored in the present study. Using a simple and reproducible method, involving radiolabelled cholesterol dispersed in Tween 20 as a tracer and endogenous lipoproteins as a substrate, the in vitro rate of cholesterol esterification in PGFF was found to be 8.7 ± 0.3 nmoles/ml/hr, ca. ¼ of that in pig serum (PS). However, the fractional rate of cholesterol esterification (percent of labelled cholesterol esterified per hour) was almost identical. Since free cholesterol concentration of PGFF is ~¼ of that of PS, it is likely that the lower rate of cholesterol esterification in PGFF is simply due to the lesser amount of cholesterol in PGFF. No appreciable change in enzymic activity was found from storing PGFF at 4 C for periods of time up to 24 hr or at −70 C up to 2 mo, but activity was lost during longer period of storage. On the other hand, PS showed a much longer period of stability (5 days at 4 C and 4 mo at −70 C). These results suggest that large molecular lipoproteins, e.g., low *density lipoprotein* (LDL), very low density lipoprotein (VLDL) or chylomicron, present in PS may have a special role in maintaining LCAT. The addition of a mixture of VLDL and LDL from PS to PGFF enhanced the rate of cholesterol esterification. Such an enhancement was not found from the addition of VLDL, LDL, or HDL alone.

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LIPID PROFILES OF MAJOR PLASMA LIPOPROTEINS OF NORMAL SUBJECTS AND PATIENTS WITH HYPERLIPEMIA. A. KUKSIS, J.J. MYHER, K. GEHER, W.C. BRECKENRIDGE, G. STEINER, and J.A. LITTLE, C.H. Best Institute, 112 College St., University of Toronto, Toronto, Ontario, Canada.

Total lipid profiles were determined by high temperature gas liquid chromatography on very low density lipoproteins (VLDL) ($d \leq 1.006$), low density lipoproteins (LDL) ($d = 1.019–1.063$), and high density lipoproteins (HDL) ($d = 1.063–1.21$) fractions of plasma from normal subjects and patients with Type II, III, and IV hyperlipemia. Despite large variations in total plasma lipids, characteristic ratios were maintained in the VLDL, LDL, and HDL fractions respectively, for esterified/free cholesterol (1.5; 2.5; 4.5), and phosphatidylcholine plus sphingomyelin/free cholesterol (1.7; 1.3; 4.4). The neutral lipid/free cholesterol plus phospholipid ratio was propotional to the particle volume/surface area ratio. Assuming that all lipoproteins are neutral lipid-core particles, the volume to surface area ratios account for the 1 to 3 proportion of free to esterified cholesterol commonly found for plasma *lipids*, while the free cholesterol/total phospholipid ratio of 1 to 1–2 in VLDL and LDL represents monolayer *compositions* where cholesterol-cholesterol contacts begin to be made but a phase separation is not observed. The HDL fraction contained phosphatidycholine in excess of free cholesterol, which suggests that in this particle much of the phospholipid is associated with protein and is not available for interaction with free cholesterol, (Supported by Ontario Heart Foundation and MRC of Canada.)

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DISTRIBUTION OF CHLORINATED PESTICIDES IN SOYBEANS, OIL, AND BY-PRODUCTS DURING PROCESSING. MUHAMMAD M. CHAUDRY, A.I. NELSON, and E.G. PERKINS, The Burnsides Research Laboratory, University of Illinois, Urbana, IL 61801.

Soybean samples were collected from seven different locales in Central Illinois and subjected to chlorinated pesticidal analysis. Different parts of the beans showed varying amounts of residue concentrations. It was found that chlorinated pesticidal residues have a tendency to accumulate, in descending order, in hulls, hypocotyles, and cotyledons. The oil extracted from cotyledons with petroleum ether was refined, bleached, and deodorized on a semimicro level. Level of free fatty acids in extracted oil was found to fall in the range of 0.7 to 1.2%. Crude oil, refined oil, bleached oil, deodorized oil, soapstock, Fuller's earth sludge, and deodorizer condensate samples were analyzed for hexachlorobenzene isomers, heptachlor, heptachlor epoxide, aldrin, dieldrin, endrin, and DDT isomers and derivatives. None of the processing steps except deodorization were found to be effective in the removal of chlorinated residues. Oil deodorized at 250 C under 1–5 mm pressure was almost free of such residues, whereas all the chlorinated pesticides found were concentrated in deodorizer condensate.

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PHASE TRANSFER AGENTS. I. TRANSFER OF PERMANGANATE, PERIODATE, AND CYANATE IONS FROM AQUEOUS TO ORGANIC PHASES. PREPARATION OF QUATERNARY ONIUM PERIODATES. TOMOYUKI OKIMOTO and DANIEL SWERN, Fels Research Institute, Department of Chemistry, Temple University, Philadelphia, PA 19122.

Several quaternary ammonium and phosphonium halides have been shown to be useful phase transfer agents (PTA) for the efficient transport of permanganate, periodate, and cyanate ions from aqueous to organic phases (benzene and/or methylene chloride). Chemical and spectral methods of analysis were used to measure ion transfer quantitatively and to assess the relative efficiency of PTA.

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PHASE TRANSFER AGENTS. II. STEREOSPECIFIC HYDROXYLATION OF OLEYL AND ELAIDYL ALCOHOL AND PERIODIC ACID CLEAVAGE OF EPOXIDES. TOMOYUKI OKIMOTO and DANIEL SWERN, Fels Research Institute, Department of Chemistry, Temple University, Philadelphia, PA 19122.

Oleyl and elaidyl alcohol have been stereospecifically hydroxylated by cold, dilute alkaline potassium permanganate to *erythro-* and *threo*-9,10-dihydroxyoctadecanol, respectively, in fair to good yields (40–80%) in a water-methylene chloride heterogeneous system. Phase transfer agents (PTA) were used to transport permanganate ion from the aqueous to the organic phase. In the absence of PTA hydroxylation did not take place. Periodic acid cleavage of epoxides in a water-methylene chloride system was studied in the absence and presence of PTA. At slow stirring rates PTA exert a rate-accelerating effect in cleaving certain epoxides to aldehydes, but with vigorous stirring, use of PTA has only a marginal advantage.

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NONTOXIC LIPIDS AS BACTERIOSTATS FOR THE FOOD INDUSTRY. JON J. KABARA and RUTH VRABLE, Department of Biomechanics, A407 East Fee Hall, Michigan State University, East Lansing, MI 48824, and M.S.F. LIE KEN JIE, University of Hong Kong, Hong Kong, China.

Fatty acids have been used as disinfecting agents since antiquity. The principal constituent of "salt water" soap, has been shown to be sodium laurate. Past data from our laboratory has incremented the importance of C_{12} acids and their esters. The present report will more closely define structure-function relations between C_{11}–C_{13} fatty acids and their monoglyceride esters. The effect of unsaturation (both ethylenin and acetylenin) in fatty acids of different chain length was determined. The role of unsaturation and esterification on antimicrobial effect of a fatty acid was evaluated. The data revealed that the most active lower chain fatty acid was a saturated 12-carbon species. The kind and position of unsaturation was not a significant variable in enhancing antimicrobial activity of fatty acids in the C_{11} of C_{12} series. While esterification of a fatty acid generally leads to an inactive compound, monoglycerides of short chain fatty acids, dodecanoic acid in particular, were more rather than less active. Monolaurin evolved as the most practical lipid surfactant to be used as a bacteriostat. The antimicrobial activity of this nontoxic material makes it a likely prospect to be used as a food preservative. Application and future role of monolaurin food industry will be discussed.

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SURFACTANTS AS REPLACEMENT FOR NATURAL LIPIDS IN BREAD BAKED FROM DEFATTED WHEAT FLOUR. O.K. CHUNG, Y. POMERANZ, K.F. FINNEY, and M.D. SHOGREN, U.S. Grain Marketing Research Center, ARS, USDA, 1515 College Ave., Manhattan, KS 66502.

Extraction of wheat flour with petroleum ether (PE) yielded 1.00% total lipids (0.70% nonpolar and 0.30% polar) and with isopropanol (PrOH) 1.36% total lipids (0.73% nonpolar and 0.63% polar). PE- or PrOH- defatted flours were baked with total, nonpolar, or polar wheat flour lipids; or equivalent amounts of sucrose monopalmitate, ethoxylated monoglycerides, or sodium stearoyl 2-lactylate (alone or in combination with wheat flour lipids); in no-shortening and 3%-shortening series. Effects on dough properties and on loaf volume and crumb grain of the three surfactants and of PE- or PrOH-extracted flour lipids differed. The differences were in responses to various replacement levels, interactions with polar or nonpolar flour lipids, and shortening-sparing effects. Breadmaking quality of PE-extracted, but not of PrOH-extracted, flours could be completely restored and even improved by the surfactants, and especially by the polar wheat flour lipids. The improvement was enhanced by shortening in PE-, but not in PrOH-extracted flours.

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NEW RESINOUS RICINOLEIC POLYOL FOR URETHANE REACTIONS. M.C. COOPERMAN and F.C. NAUGHTON, Industrial Chemicals Division/NL Industries, Inc., PO Box 700, Hightstown, NJ 08520.

A new resinous polyol has been described based on an extension of Epon Resin 829 with Bisphenol A and further esterification with ricinoleic acid. A modified short oil alkyd fusion reaction was developed following previously employed techniques. The method was modified by reaction with ricinoleic acid, a 12-hydroxyoleic acid, the main fatty acid component of castor oil. The resinous polyol derived from this technology is designated Ester 597. Ester 597 was further reacted with a series of urethane prepolymers based on castor oil. A two-component formula based on this technology was used to prepare a two can epoxy-urethane coating system.

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AUTOMATION OF A MARGARINE BATCHING OPERATION. AHMAD MOUSTAFA and CHARLES STRUBLE, The Miami Margarine Co., 5226 Vine St., Cincinnati, OH 45217.

After a number of years during which margarine batches were weighed out manually our company installed on automatic batch weighing system. This system was put into operation in 1965. The main transducer was a Baldwin, Lima, Hamilton load cell. Signals from the load cell were processed electronically to create a digital input into the main body of the controller. The system was provided with a card reader so that the formulas could be punched into a standard 80 row, 12 column IBM card. Operating data such as midair compensation and dribble cut-off were also punched into the formula cards. As the age of the system increased and maintenance problems increased due to component aging and breakdown, a decision became necessary to either completely overhaul the system or replace it. At this point it was decided to replace the automatic controller with a mini-computer. The advantage of the mini-computer appeared to be greater accuracy in batching due to the computer's ability to calculate corrections instantly for batch variations, faster more reliable operation, visual display of formulas and batching data and other information, and retainment of batching data for inventory purposes and management information. The computer was installed and we learned that program development and software manipulation were as important as hardware. We also learned that environmental electronic noise has a profound effect in interfering with the operation of the computer.

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COMPOUND FORMATION OF SATURATED TRIGLYCERIDES. T.C. VAN SOEST, Unilever Research, Vlaardingen, The Netherlands.

The phenomenon of the formation of compounds (a 1:1 complex in the crystalline state) of saturated triglycerides has been studied. Starting from the known crystal structures of the β-2 modifications with type A and type B methyl terraces (see also poster 1) a large number of binary systems which in theory could give β-2 compounds have been derived. The triglycerides concerned have been synthesized and crystallized from a chloroform solution after which the crystals were investigated by powder x-ray diffraction. Three types of β-2 compounds have been found which can be distinguished on the basis of the methyl terraces present: A, AB, and B. The number of β-2 compounds actually observed is largest for type A and smallest for type B. The reason is that the β-2 form of type A is the more stable modification (see also

poster 1). Simple rules have been formuated with which the possible occurrence of a compound as well as its melting point can be predicted. A general result of this work is the finding that two suitably selected triglycerides are able to crystallize as a 1:1 complex because its lattice energy is larger than the sum of the lattice energies of the most stable phases of the two components. A second important outcome is that mainly the methyl terrace is responsible for this difference.

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EFFECTS OF VARIOUS ENVIRONMENTS UPON THE FLUORESCENCE OF AFLATOXINS ON THIN LAYER CHROMATOGRAPHY PLATES. PAUL F. VORNHEDER and CARL C. STOPHLET, JR. Procter & Gamble Co., Winton Hill Technical Center, 6071 Center Hill Rd., Cincinnati, OH 45224.

A definitive study has been performed on the effects of various gaseous vapors and light environments upon the fluorescent stability of pure aflatoxin standards and peanut butter extracts on thin layer chromatography (TLC) plates. It was determined that rapid fading of aflatoxins on TLC plates can occur when certain atmospheric contaminants are present. The major environmental factors which caused excessive fading included chlorine gas, nitrogen trioxide and dioxide, ozone, sunlight, hydrogen chloride, and ammonia. The nitrogen oxides and ozone parallel experiences encountered during high atmospheric pollution alerts. The other gases are more common to a typical laboratory situation wherein many chemical operations may be going on. Other common agents which also adversely affect the quality of aflatoxin results are cited. A major observation was that frequently aflatoxin standards were affected (bleached) more than sample spots even when on the same TLC plate.

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PALM OIL PROCESSING. R. HRUSHOWY, Canada Packers Limited, 2240 St. Clair Av. West, Toronto, Ontario, M6N 1K4.

Palm oil utilization is contingent on three key factors: economic advantage, standards of quality, and customer acceptance. In order to provide acceptable quality palm oil for direct use or as a portion of a formuation, the oil is pretreated, steam refined, bleached, and deodorized. A Parkson stripper is employed for steam refining which, with the pretreatment described, results in yields of 1.19 × F.F.A. (% as oleic) and finished oil colors ranging from 1.0–2.5 Red Lovibond. Potential color problems can be avoided by ensuring that all storage and processing conditions are controlled.

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FATE OF CAROTENOIDS DURING PALM OIL PROCESSING. HENRYK DAUN and STEPHEN S. CHANG, Rutgers, The State University, Department of Food Science, PO Box 231, Cook College, New Brunswick, NJ 08903.

The use of palm oil in food products has greatly increased during recent years due to its availability and price structure. Processing of this oil includes heat treatment in some cases up to 270 C. Carotenoids which constitute in typical planation oils 400–700 ppm are subjected to chemical changes during processing. Toluene, M-xylene, P-xylene, 2,6-dimethylnaphthalene, and ionene were identified among the volatile thermal decomposition products of carotenoids at temperatures simulating processing conditions. The same substances were isolated and identified from processed palm oil. Nonvolatile fraction of carotenoids pyrolysate contains a mixture of hydrocarbons, oxydized when sorted in the air. Although this fraction accounts for 95 to 98% of the initial amount of carotenoids, the exact chemical structure of its components is not known. From the unsaponifiable part of thermally treated palm oil, substances with similar R_f values were isolated. Further research is needed on the fate of carotenoids during palm oil processing.

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INTERNATIONAL STANDARDS FOR PALM OIL. J.A. CORNELIUS, Tropical Products Institute, 56/62 Gray's Inn Road, London WC1X 8LU, England.

Crude palm oil for edible purposes has for many years been sold on the basis of moisture, dirt, and free fatty acid (FFA) contents. With an increasingly competitive market, user requirements with regard to quality characteristics are becoming more closely defined so that the producer can market an oil which can be refined to particular standards of color, taste, consistency, and shelf life at minimum cost to the refiner. Other tests for palm oil quality developed over the last 20 yr include assessment of bleachability, oxidation, and oxidative stability. With the prospect of oils with a higher unsaturated acid content from African-American hybrid palms being produced commercially, and the present interest in fractionation, fatty acid composition is likely to become a more important quality factor. Progress to date on standard procedures for the assessment of crude palm oil quality is reviewed and possible standards for refined, bleached, deodorized, and fractionated palm oils are discussed.

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USE OF TERTIARYBUTYL HYDROQUINONE IN STORAGE OF CRUDE PALM OIL. JAMES E. HUFFAKER, Eastman Chemical Products, Inc., B-230, Kingsport, TN 37662.

An optimization experiment in the laboratory led to a specific effective combination of TBHQ and citric acid for a new product for treating crude palm oil for storage stability. The new product was evaluated full scale in a palm oil refinery with the following conclusions: the product is effective, economical, and subsequently removed by deodorization.

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PALM OIL FRACTIONATION. RICHARD KASSABIAN, Anadik, Inc., 504 76th St., North Bergen, NJ 07047.

A general review of the systems currently available will be made. Particular attention will be given to the chemistry involved and the ability of each system to achieve separations suitable for temperate zones and tropical zones. Specific information on the plant equipment and layouts required for the ANADIK System will be given. Production costs and capacities will be analysed.

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THE H.L.S. PALM OIL FRACTIONATING PROCESS. H.L.S. RESEARCH TEAM, H.L.S. Ltd., PO Box 193, Petah-Tikva, Israel.

The fractional crystallization of palm oil must give, on the one hand, a relatively large liquid fraction with the lowest possible chilled stability for use as salad oil, and on the other hand, several hard fractions with characteristics suitable for the requirements of the fat industry. It was not possible to achieve the two abovementioned conditions by a single fractionating process due to the very special structure of palm oil. We therefore developed several basically different fractionating processes. (a) A physical fractional crystallization using isopropyl alcohol as solvent without changing the structure of the palm oil and triglyceride molecules which permits obtaining several hard fractions. The liquid fraction has a medium chilled stability, namely 25 C. It allows the separation of the solid fraction crystals in one or two stages by simple decantation without filtration or centrifugation. The process is covered by patent all over the world. (b) A chemical fractionating process proceeding to the redistribution of the fatty acid radicals in the palm oil triglyceride molecules by transesterification, using alkyl esters as fatty acid radicals carriers. This process permits obtaining a relatively large liquid fraction with low chilled stability, namely 8 C, but only one single hard fraction with a definite composition, containing over 90% palmitic acid and an iodine value of 5. Nutritional experiments carried out on animals have shown that the liquid fraction is very well tolerated and is much superior to cottonseed oil. This process too is covered by patent all over the world. (c) A chemical process proceeding to the full conversion of palm oil into a single fraction of unsaturated liquid oil by the creation of double bonds in the chain of palmitic acid. This method has not yet been used for edible purposes. The nutritional behavior of the liquid product will soon be checked. The two processes first mentioned above already have industrial application and the third is in the pilot scale stage of experimentation.

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DEVELOPMENTS ON PALM OIL QUALITY. MARSHALL PIKE, Harrisons and Crosfield, Camberley, Surrey, England.

Abstract not available at press time.

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REGULATION OF LIPOGENESIS IN AVIAN HEPATOCYTE CULTURE. DAVID M. TARLOW and M.D. LANE, Department of Physiological Chemistry, Johns Hopkins Medical School, Baltimore, MD 21205.

A primary nonproliferating avian hepatocyte cell culture system has been utilized in order to study the regulation of fatty acid biosynthesis. Single hepatocytes isolated by a collagenase treatment from fasted 21 day old chicks (45–48 hr fasted) have a markedly depressed fatty acid synthetic capacity. Acetyl-CoA carboxylase activity measured from these cells contains only about 15–20% of the activity measured from hepatocytes isolated from fed chicks. This enzyme can be induced from cells isolated from fasted chicks in cell culture when insulin (5 μg/ml) is administered. The time course of induction is unique in that it is not manifested until almost 50 hr in culture. After this time, the increase in activity is linear until about 110 hr where a plateau in enzymatic activity is achieved. The rate of carboxylase activity increase is about 2.1 mU/plate/10 hr/10^7 cells which corresponds to 0.21 μg/plate/10 hr/10^7 cells if the increase in enzymatic activity is due to new synthesis of enzyme. Acetate incorporation into fatty acids also follows similar kinetics. Glucagon (5 μg/ml) or cyclic AMP (0.1 mM) will prevent the induction of acetyl-CoA carboxylase when added at any time before the rise in activity of the enzyme, even in the presence of insulin. After 50 hr the presence of cyclic AMP or glucagon prevents any further increase in enzymatic activity. However any existing activity is not diminished in the presence of these compounds for at least 90 hr. Cyclic AMP, once added, can be removed with a coordinated increase in fatty acid biosynthesis and acetyl-CoA carboxylase activity. This inhibition due to cyclic AMP or glucagon appears to be quite specific with no gross effect on RNA or protein synthesis.

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THE EFFECTS OF QUANTITY AND QUALITY OF DIETARY FAT AND CARBOHYDRATE IN VITRO SYNTHESIS OF PROSTAGLANDINS E_1, E_2, AND $F_{2\alpha}$ AND PLASMA FATTY ACID COMPOSITION IN IRRADIATED BEAGLE DOGS. ELIZABETH J. MCCOSH and JACQUELINE DUPONT, Department of Nutritional Sciences, U-17, University of Connecticut, Storrs, CT 06268.

Chronic renal insufficiency has been produced in beagle dogs by a single, whole-body exposure to ^{60}Co gamma radiation either at 55 days in utero or at 2 days postpartum. Subsequently, many develop chronic renal insufficiency which is characterized by severe generalized glomerulosclerosis accompanied by variable amounts of periglomerular and interstitial fibrosis. The onset of chronic renal insufficiency is slow and progressive, and the degeneration of renal function appears to follow a clinical pattern similar to that seen in humans. For 3 mo, 5-to-6-yr old irradiated dogs were fed semipurified diets with vitamin, mineral, and protein content comparable to Purina Dog Chow (P) and with: (a) fat and carbohydrate also as in (P), (b) high disaccharide, high saturated fat, or (c) high starch, high polyunsaturated fat. At 1-mo intervals maximal, in vitro platelet synthesis of prostaglandins E_1, E_2, and $F_{2\alpha}$ were determined by radioimmuno assay, and at the end of third month the plasma fatty acid composition was determined by gas liquid chromatography. The data showed that prior to dietary treatment in the irradiated dogs, platelet synthesis of prostaglandin E_1 was greater than in normal dogs, prostaglandin $F_{2\alpha}$ was slightly less in the irradiate dogs than in the normal dogs, and there was no difference in prostaglandin E_2. Following dietary treatment dogs fed diet (b) showed a significant increase in prostaglandin E_2, while dogs fed diet (c) showed a significant decrease in prostaglandin E_2. Dogs fed diets (a) and (b) showed an increase in prostaglandin E_1. Dogs fed diet (c) showed a decrease in prostaglandin $F_{2\alpha}$. Fatty acid composition data will be presented. (Supported in part by Colorado Heart Assoc. and USPHS NIH grant HL70517.)

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THE ACTIVATION OF A PLASMA MEMBRANE ENZYME BY CONCANAVALIN A IN POLYMORPHONUCLEAR LEUKOCYTES. (HONORED STUDENT PRESENTATION). MICHAEL HAMRELL and PAUL HOCHSTEIN, Department of Pharmacology, USC School of Medicine, 2025 Zonal Avenue, Los Angeles, CA 90033.

Phagocytosis in human polymorphonuclear leukocytes (PMN) is accompanied by specific alterations in the oxidative metab-

olism of the cell. Certain surface-active agents, and plant lectins such as Concanavalin A (Con A), will interact with the membrane of the PMN to cause a reversible stimulation of the phagocytic oxidative metabolism. Recently, a plasma membrane located enzyme, responsible for an enhanced oxygen consumption, has been demonstrated. This ectoenzyme is believed to be responsible for the increased metabolism accompanying phagocytosis. The nonpenetrating, plasma membrane sulphydryl group inhibitor, p-chloromercurobenzene sulfonic acid (p-CMBS), shows a partial inhibitory effect on latex and Con A stimulated cells. The production of hydrogen peroxide and superoxide initiated by latex and Con A treated cells gives a sevenfold and fourfold stimulation respectively over controls which is inhibited 25% by p-CMBS during a 5 min incubation period. This stimulation of cells by Con A suggests that mere perturbation of the plasma membrane is sufficient for the stimulation of the cells. The location of an ectoenzyme that uses nicotinamide adenine dinucleotide (NADH) or reduced nicotinamide adenine dinucleotide phosphate (NADPH), which presumably comes from intracellular pools, to generate superoxide and peroxide, suggests a role for the plasma membrane in the phagocytic process. Perturbation of membrane lipid and protein components by Con A or latex particles may be the initiating event in the metabolic and morphological changes associated with bacterial killing. This activation of the enzyme suggests a major regulatory role for the plasma membrane in phagocytic processes.

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STUDIES ON THE CHEMICAL COMPOSITION OF INTERNAL HUMAN HAIR LIPID. OKIHIKO SAKAMOTO, YOSHIMORI FUJINUMA, and TATSUYA OZAWA, Shiseido Laboratories, 1050 Nippa-cho, Kohoku-ku, Yokohama, Japan.

Identification of hair lipid obtained from the hair by ordinary Soxhlet extraction was made by several workers; however, that of internal occurrence was not reported up to this time. We investigated the internal human hair lipid in the following manner and obtained several new findings. Hair from the known source was washed by detergent and underwent Soxhlet extraction for 100 hr by dichloromethane and then was carefully homogenized in ethanol under cooling. After the centrifugal separation, the ethanol soluble part was quantitatively analyzed, while the corresponding residual part further underwent HCl-refluxing and was analyzed by thin layer chromatography (TLC) and gas chromatography-mass spectrometry (GC-MS). Following results were obtained. (a) The internal hair lipid of ca. 1% to the total hair was obtained after the removal of external hair lipid by the exhaustive Soxhlet extraction. (b) The internal hair lipid in total was mainly composed from n-sat. fatty acids (68%) and wax esters (9%). The constituent pattern was different from those of sebum and fresh hair lipid reported, which contained four main components of glycerides, fatty acids, wax esters, and squalene. (c) Distribution pattern of the carbon number of the constituent fatty acids in the internal hair lipid was compared with that of sebum and we found the similar n-C_{18} predominance along with the difference in the content of n-sat. and unsat. C_{18} fatty acids. (d) The composition pattern of the internal hair lipid obtained from the residual part by HCl-decomposition was different from that of the ethanol soluble part. This suggests the specific distribution of the hair lipid components in hair keratin.

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THE CONTRIBUTION OF QUANTITATIVE THIN LAYER AND GAS CHROMATOGRAPHIC ANALYSIS IN ELUCIDATING THE COMPOSITION OF DOG SKIN SURFACE LIPIDS. DAVID M. SHARAF and DONALD T. DOWNING, Boston University School of Medicine, 80 East Concord St., Boston, MA 02118.

Previous workers have shown that the skin surface lipid of the dog contains a high proportion of long chain fatty acid diesters of long chain 1,2-diols. These diesters were known to have a lower mobility on thin layer chromatography than diesters from other species in spite of containing similar fatty acid and diol components. In the present study, the component lipid classes from dog skin were separated by preparative thin layer chromatography into sterol esters (49%), wax diesters (33%), free sterols (8%), polar lipids (6.5%), and an unidentified component (3.5%). The hydrolysis products of the diesters were analyzed by quantitative thin layer chromatography and were found to contain one mole of fatty acids per mole of diols rather than the two moles required for diester formation. By handling the fatty acid products of hydrolysis only as the nonvolatile tetramethylammonium salts and by pyrolyzing these salts to methyl esters within a gas chromatographic system, it was found that missing fatty acid moiety was contributed by volatile branched chain fatty acids, predominantly isovaleric acid. The principal constituents of the diols were branched chain C_{21} and C_{22} compounds while the long chain fatty acids esterified with them were mainly C_{20} and C_{21} branched and multibranched compounds. The fatty acids from the sterol esters were almost entirely saturated, branched chain C_{19} to C_{23} compounds with 7.5% of straight chain monounsaturated (ω7 and ω9) acids, principally C_{21} and C_{22}. There were only trace amounts of free sterols other than cholesterol while the esterified sterols contained 96% cholesterol and 4% of lathosterol.

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WAX ESTERS IN THE K^n MUTATION OF THE DOMESTIC CHICKEN. HELEN E. WALKER and RALPH C. SOMES, JR., Department of Nutritional Sciences, U-17, University of Connecticut, Storrs, CT 06268.

The sex-linked K^n mutation of the domestic fowl causes the uropygial gland to develop to a size three times that of normal. Part of this increased size is due to increased amount of oil in the gland. The wax esters in the glands of the normal, heterozygous, and homozygous offspring from appropriate crosses were first purified by thin layer chromatography and then saponified with boron fluoride in methanol. The resulting methyl esters and diols as acetonides were examined by gas liquid chromatography. These results will be discussed.

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MATERNAL INFLUENCE ON HUMAN PLASMA CHOLESTEROL. JOE C. CHRISTIAN and KE WON KANG, Department of Medical Genetics, Indiana University School of Medicine, 1100 West Michigan Street, Indianapolis, IN 46202.

Recent twin studies of plasma cholesterol have revealed unequal total variances for human monozygotic (MZ) and dizygotic (DZ) twins. This difference in total variance, present in adult and newborn twins, was interpreted as evidence for prenatal maternal influences on cholesterol. The children of MZ twins were studied to search for evidence of maternal influences on singleton infants. As MZ twins have identical genes and similar environments their offspring are more closely related than first cousins and if maternal influences are stronger than paternal influences, the offspring of female MZ twin-pairs (female-twin sibships) should be more similar than those of male MZ twins (male-twin sibships). Plasma cholesterol was measured in fresh, fasting plasma samples from 424 children (aged 2–36 yr) of 34 male and 49 female MZ twin-pairs. The variation between the male-twin sibships was significantly greater than between female-twin sibships (F ratio 1095/557 mg/100 ml^2; $P < .05$), consistent with the hypothesis of stronger maternal influences. A recent study of cholesterol levels in swine also revealed a closer relationship of maternal half-siblings than of male half-siblings [Rothschild and Chapman, *J. Hered.* 67:47 (1976)]. These authors postulated either maternal influences or dominance deviations. We do not believe these findings are compatable with genetic dominance but strongly suggest maternal influences. In a trait where much of the variation is set by early maternal influences, attempts to change the phenotype in adult life may be disappointing. Therefore, perhaps the time to lower plasma cholesterol levels and prevent atherosclerosis is in infancy or before birth.

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REVERSAL OF LINOLEATE INDUCED INHIBITION OF HEPATIC LIPOGENESIS BY EICOSA 5,8,11,14-TETRAYNOIC ACID (TYA). G. ANANDA RAO, Veterans Administration Hospital, 150 Muir Rd., Martinez, CA 94553, and S. ABRAHAM, Bruce Lyon Memorial Research Laboratory, Children's Hospital Medical Center, Oakland, CA 94609.

We reported previously that feeding a 15% corn oil-diet containing 0.033% eicosa 5,8,11,14-tetraynoic acid (TYA) for 6 wk increased both the content of total fatty acids and the relative proportion of linoleate whereas it decreased the relative proportion of arachidonate in mouse livers. Thus, TYA inhibits the hepatic conversion of linoleate to arachidonate. The present study was carried out to investigate the effect of dietary TYA on hepatic lipogenesis. Liver slices from C3H mice fed, for 4 wk, a 15% corn oil-diet with or without TYA, were incubated with $1^{14}C$-acetate and ^3H_2O. The radioactive fatty acids produced were quantitated. Carbon from acetate and tritium from water were converted to fatty acids/100 mg tissue/3 hr two- to threefold higher when TYA was added to the corn oil-diet than when absent. In other experiments, liver slices were obtained from mice fasted for 2 days and refed a 15% corn oil-diet with or without TYA for 4 days and fatty acid synthesis again measured with $1^{14}C$-acetate and ^3H_2O as substrates. Once again, dietary TYA resulted in a twofold stimulation in the rate of hepatic fatty acid synthesis. The percentage of linoleate in the total fatty acids of the livers of these mice increased whereas the percentage of arachidonate decreased so as to alter the values for the $C_{18:2}$:$C_{20:4}$ ratio from 2.1 to 8.1. Thus, even short-term feeding of TYA was effective in inhibiting the synthesis of arachidonate from linoleate. Our results demonstrate that lipogenesis could be stimulated even when the liver contained high levels of linoleate if arachidonate levels were low. It would therefore appear that the increased lipogenic rate is related to the reduced levels of arachidonate. Support for the concept that high linoleate is not the main contributor to decreased lipogenesis but high arachidonate is, was obtained by the following experiment. When arachidonic acid was added (0.25%) to the corn oil-TYA diet, a depression of hepatic lipogenesis was observed. Inhibition of hepatic lipogenesis as a result of feeding corn oil as compared to a high carbohydrate fat-free diet, was almost completely, but not fully reversed, by adding TYA to the diet. Such results suggest that factors other than the reduced level of arachidonic acid may also play a role, although minor, in the regulation of hepatic lipogenesis. (Supported by Veterans Administration Hospital, Martinez, CA; and a U.S.P.H. Grant, CA 11736, from the National Cancer Institute, DHEW.)

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INFLUENCE OF ELECTROLYTES ON THE COLLOIDAL BEHAVIOR OF FABRIC SOFTENER SYSTEMS. H.H. HSING, L. HUGHES, and M.L. DEVINEY, Ashland Chemical Company, PO Box 2219, Columbus, OH 43216.

The zeta-potentials (electrophoresis) of two commercial fabric softeners, Adogen 442 and Varisoft 475, in the presence of the surfactant sodium lauryl sulfate (SLS) were measured. The results reveal a correlation between zeta-potential and softener deposition of the cotton surfaces. The zeta-potential changes from positive in the softener-rich systems to negative in surfactant-excess systems. The addition of excess surfactant redisperses the colloidal particles of the softener/surfactant complex due to the external adsorption of free surfactant onto the softener/surfactant complex particles, providing repulsive negative charges between the particles. The effectiveness of electrolytes in reducing the negative zeta-potential of V475/SLS systems (SLS in excess) follows the Schulze-Hardy rule and is in the order of $Al^{+++} > Ca^{++} > Na^{+}$. The deposition inhibition of V-475 and V475/SLS systems by the detergent builders Na_2CO_3, Na_2SiO_3, and sodium tripolyphosphate agrees with the zeta-potential results and is due to the builder's ability to shift positive surface charges to negative. This establishes the builders as potential-determining electrolytes for V475-rich systems. Sodium carboxymethyl cellulose is an effective electrolyte in shifting the softener system's zeta-potential from positive to negative, thus effectively inhibiting the softener deposition.

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THE DECISIVE ROLE OF DIETARY CHOLESTEROL AND FAT IN THE PREVENTION OF ATHEROSCLEROSIS. WILLIAM E. CONNOR, Department of Medicine, University of Oregon Health Sciences Center, 3181 S.W. Sam Jackson Park Rd., Portland, OR 97201.

While many factors contribute to the pathogenesis of atherosclerosis, hypercholesterolemia is the crucial prerequisite. The source of the cholesterol in the cholesterol-rich plaque of the arterial intima is cholesterol from the blood carried largely by low density lipoproteins. Elevated plasma cholesterol levels, although inevitably set for some individuals by genetic factors, are caused by the excessive consumption of dietary cholesterol and saturated fat for the vast majority of our population. There are four main lines of evidence dating from 1908 to

the present which particularly relate dietary cholesterol and saturated fat to hypercholesterolemia and atherosclerosis. These are: (a) worldwide epidemiological studies, (b) animal experiments, (c) human feeding experiments, and (d) the pathologic-isotopic findings. Of particular note is that dietary cholesterol correlates very well with both plasma cholesterol levels and coronary heart disease in populations throughout the world. Cholesterol is the *sine qua non* dietary substance necessary to produce hypercholesterolemia and atherosclerosis in animals. Dietary cholesterol, alone or in company with saturated fat, elevates plasma cholesterol levels in man. Finally, the predominance of cholesterol and cholesterol ester in atherosclerotic lesion suggests that atherosclerosis represents a cholesterol storage disease. Thus, the prevention of atherosclerotic coronary heart disease is a major public health challenge which can be met by certain changes in the current American diet. Such dietary changes would need to lower the mean plasma cholesterol concentrations and lessen the plasma low density lipoproteins of the population in question. The recommended diet would drastically reduce dietary cholesterol and saturated fat derived largely from animal food sources and would increase the consumption of cereals, legumes, and other vegetable foods. Such a diet has produced the regression of atherosclerosis experimentally induced in monkeys. This "alternative diet" is nutritionally superior and meets all of the criteria for the dietary prevention of atherosclerosis in man.

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DIETARY PROTEIN IN RELATION TO ATHEROSCLEROSIS. KENNETH K. CARROLL, Department of Biochemistry, University of Western Ontario, London, Ontario, Canada N6A 5C1.

Dietary protein has generally been considered to be of little importance in the etiology of atherosclerosis, although animal protein intake correlates as well as any other dietary variable with mortality from atherosclerotic heart disease in different countries of the world. There is also evidence from studies on human subjects that the type and amount of protein in the diet can influence serum lipid levels, which in turn may affect the development of atherosclerotic lesions. Experiments in our laboratory have shown that the hypercholesterolemia and atherosclerosis which develop in rabbits fed cholesterol-free semipurified diets is dependent on the presence of animal protein in such diets, and can be prevented by replacement of the animal protein by various plant proteins. Further studies are being carried out to identify the components in the protein preparations which influence the level of plasma cholesterol and to investigate possible mechanisms involved. (Supported by the Ontario Heart Foundation and the Medical Research Council of Canada.)

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FIBER IN HYPERCHOLESTEREMIA AND ATHEROSCLEROSIS. DAVID KRITCHEVSKY and JON A. STORY, The Wistar Institute, 36th and Spruce Streets, Philadelphia, PA 19104.

Epidemiological studies indicate that populations ingesting diets high in fiber are subject to fewer of the diseases of Western civilization (such as heart disease) than are other populations. Whether this is due to their intake of dietary fiber or to other aspects of lifestyle has yet to be determined. Rats fed semipurified diets containing cholesterol exhibit a slight increase in serum cholesterol and a very large increase in liver cholesterol. Addition of fiber to the diet (pectin, vegetable gums, etc.) causes significantly less deposition of liver cholesterol. Pectin appears to increase excretion of acidic fecal steroids and alfalfa seems to increase excretion of fecal neutral steroids. The addition of saturated fat to a semipurified diet will result in atherosclerosis in rabbits but addition of the same amount of the same fat to stock diet will not. The difference is most probably due to the plant residues present in the stock diet. Pectin has been shown to inhibit cholesterol-induced atherosclerosis in rabbits and chickens. Alfalfa also inhibits atherosclerosis in cholesterol-fed rabbits and if fed in sufficient quantity will even inhibit cholesteremia. In man, bran has been shown to have no effect on serum cholesterol or triglyceride levels but pectin and vegetable gums are reported to have a hypocholesteremic effect. Complete understanding of the action of dietary fiber on lipid metabolism will depend upon careful analysis of the fiber and eventual delineation of which particular component exerts a specific effect.

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DIETARY FACTORS IN ARTERIOSCLEROSIS: SUCROSE. JOHN YUDKIN, London University, 16 Holly Walk, London N.W.3, England.

Three features of coronary heart disease (CHD) help in our search for its causes. First, it is associated with several biochemical and other abnormalities Second, it is associated with a number of other diseases in varying degree, including diabetes, peripheral vascular disease, gout, and peptic ulceration. Third, there is wide if not universal agreement that the chances of developing CHD are increased by sedentariness, cigarette smoking, obesity, and a family history. The multiplicity of abnormalities in CHD includes an increase in blood concentration of cholesterol, triglyceride, uric acid, and blood sugar; diminished glucose tolerance; and an increase in both adhesiveness and rate of aggregation of blood platelets. All these abnormalities can be produced by dietary sucrose. There are many and apparently unrelated points to a hormonal disturbance as the underlying mechanism that produces CHD, and this is supported by the lower prevalence of the disease in young women and the loss of this relative immunity after the menopause. CHD is in fact accompanied by increased blood insulin and cortical hormone. Blood insulin is also raised in maturity onset diabetes and obesity, and by cigarette smoking, while it is reduced during physical activity. These facts tie together the accepted causes of the disease through a possible common mechanism of raised insulin, and they add to the experimental evidence that dietary sucrose is a cause, since this too increases the concentration of insulin, as well as that of cortical hormone. Finally, the link between CHD and other diseases can also be explained by the known effects of dietary sucrose. Obesity is commonly caused by excessive sugar intake; gout is accompanied by a raised concentration of blood uric acid, as is consumption of sucrose; the symptoms of chronic dyspepsia are relieved by a sugar-low diet, while a sucrose-rich diet increases both gastric acidity and pepsin activity.

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DIET AND HUMAN ATHEROSCLEROSIS. GEORGE V. MANN, Vanderbilt University School of Medicine, Department of Biochemistry, Nashville, TN 37232.

The hypothesis relating coronary heart disease to dietary fat has not been supported by extensive clinical trials. Research on causes and prevention of atherosclerosis has been stalemated by delays in abandoning this sterile postulate. While atherosclerosis is found in subjects living in all human societies examined there are striking differences of extent among individuals. The form of the atherosclerotic lesion is influenced by the degree of cholesteremia, being more fibrous and less obstructive in persons with low levels of cholesteremia. Dietary fat has measurable but inconsequential effects on cholesteremia. Only one in 500 Caucasians has genetically determined hypercholesteremia (HTC). Most of the rest have acquired HTC. The metabolic lesion in the rare genetic hypercholesteremia has been shown to be at a cell receptor site for low density lipoproteins (LDL). The lesion in acquired hypercholesteremia has not been unequivocally identified but seems to be at the level of the conversion of cholesterol to bile acid precursors. The infatuation with lipoproteins has delayed research in this area. The epidemiological evidence suggests that some environmental agent is responsible. This is not total dietary or saturated fat or dietary cholesterol. It is still plausible to suppose that some dietary agent, some technical artefact in the diet, say *trans*-fatty acids, might be responsible. Dietary *trans*-fatty acids are hypercholesteremic when fed to man with modest intakes of cholesterol. Until the prevention of cholesteremia as an aggravator of atherogenesis becomes available, the most promising preventive for cardiovascular disease is exercise and the vascular compensation which it produces. Fit and active people have less coronary disease at any level of cholesteremia. The current dogmatic dietary treatments are presumptuous and misleading.

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APPLICATIONS OF COMPUTER INTERPRETATION OF MASS SPECTRA AND HIGH PRESSURE LIQUID CHROMATOGRAPHY-MASS SPECTROMETRY TO LIPID RESEARCH. F.W. MCLAFFERTY, Department of Chemistry, Cornell University, Ithaca, NY 14853.

Our system for the direct coupling of high pressure liquid chromatography and mass spectrometry (HPLC/MS) will be described. In this method direct on-line monitoring of HPLC is made possible by continuous introduction of a fraction of the eluted solution into a chemical ionization mass spectrometer (MS). Direct coupling of this system to the computer (COM) gives advantages now well known for GC/MS/COM systems, including subnanogram detection sensitivity and real-time display of mass chromatograms. Algorithms for the computer identification of mass spectra are now available from the Cornell computer via the TYMNET international computer networking system. Unknown mass spectra can first be compared against a reference file of 41,429 spectra of 32,433 different compounds using the Probability Based Matching (PBM) system. Its demonstrated superiority is due to its "weighting" of mass and abundance data, and to its "reverse search" which is especially valuable for mixture spectra. Unknown spectra for which PBM matches of sufficient reliability cannot be found can then be examined by the Self-Training Interpretive and Retrieval System (STIRS) which matches the unknown spectral data in 15 preselected categories against a large reference collection. The best matching compounds in each data class indicate possible substructural features; for 200 of these the computer actually provides a confidence level prediction of the substructure's presence. PBM or STIRS examination of an unknown spectrum usually requires much less than one minute; a variety of examples will be given.

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MASS SPECTROMETRY OF LIPIDS LABELED WITH STABLE ISOTOPES. WILLIAM K. ROHWEDDER, Research Center, ARS, USDA, 1815 North University, Peoria, IL 61605.

Stable isotopes can be useful in determining the mechanism of reactions in many different fields such as hydrogenation, oxidation, human metabolism, photosynthesis, and nitrogen fixation. Mass spectrometry is the most practical method of measuring stable isotopes, and with careful selection of the method of labeling it is often possible to locate the position of the label and the amount of label with good accuracy. Qualitative isotope work can be done with gas chromatography-mass spectrometry (GC-MS) and standard slow scan MS can give useful quantitative results, but the best values are recorded using selected ion monitoring techniques. Calculations are straightforward with single labeling situations, but a least squares solution must be used when there are mass peak interferences. Dual- and triple-labeled samples can be used to follow the metabolic path of fats in humans. The ultimate limit of accuracy is the statistical variation in the number of ions hitting the electron multiplier of the mass spectrometer.

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ANALYSIS OF α-BRANCHED CHAIN FATTY ACIDS BY GAS CHROMATOGRAPHY AND MASS SPECTROMETRY. T.A. FOGLIA, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane Philadelphia, PA 19118.

Isomeric α-branched chain fatty acid methyl esters can be identified by the combined use of gas liquid chromatography and mass spectrometry. For a given isomeric series of α-branched methyl esters, equivalent chain length values decrease with an increase in either the number or size of α-alkyl substituents. The mass spectra of the α-branched methyl esters are characterized by prominent McLafferty rearrangement ion peaks. Differentiation of isomeric α-monoalkyl and α,α-dialkyl methyl esters can be made, since the former have prominent molecular ions, while the latter have prominent α-cleavage ions. The application of this method of analysis to complex mixtures of highly α-branched fatty acids obtained in synthesis will be described.

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A SIMPLE GAS CHROMATOGRAPHY-MASS SPECTROMETRY TECHNIQUE FOR THE IDENTIFICATION OF ODORIFEROUS CONTAMINANTS IN FATS AND OILS. SHERMAN S. LIN, JAMES K. MAINES, and THOMAS H. SMOUSE, Anderson Clayton Foods, Richardson, TX.

The contamination of odoriferous materials in fats and oils occurs occasionally during processing or shipment. When

such incidents happen, two important questions arise and need immediate answers: what is the contaminant and what is the source of contamination? After the contaminant is positively identified, the source of contamination can usually be determined by knowing the history of the contaminated fats or oils. A simple gas chromatography-mass spectrometry (GC-MS) technique has been developed and successfully applied for identifying the odoriferous contaminant in fats or oils. Details of this technique and examples of contamination will be presented.

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MASS SPECTROMETRIC BEHAVIOR OF FATTY ETHER DERIVATIVES. M.E. RENNEKAMP, P.J. MENARDI, W.E. LINK, and G.E. SITZ, Ashland Chemical Company, Research and Development, 5200 Blazer Parkway, Dublin, OH 43017.

The electron impact induced decomposition of fatty ether derivatives with the general structure R–O–CH_2–CH_2–R′ where R is C_8H_{17} and $C_{10}H_{21}$ and R′ is $-CH_2NH_2$, $-CN$, $-CH_2OH$, $-OCOCH_3$, $-CNH_2$ and $-CH_2NHCCH_3$ has been examined. Although the synthesis of a number of these compounds has been demonstrated in the literature, their mass spectrometric behavior has not been reported. With the exception of the nitrile derivative, there are very few high mass ions formed during fragmentation of these compounds. Only the fatty ether amine, R–O–$CH_2CH_2CH_2NH_2$, showed the presence of a molecular ion. The mass spectra of the ester, alcohol, and nitrile included fragmentation patterns typical of long chain hydrocarbons. Characteristic rearrangement ions are observed in the derivatives of the alcohol, ester, and amide. Two of the compounds, R′ = $-CH_2OH$ and $-OCCH_3$ (O above C), exhibited very similar mass spectra.

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HYDROCARBONS IN MARINE ORGANISMS AND SEDIMENTS OFF WEST GREENLAND. POUL JOHANSEN, ARNE BÜCHERT, and VIBEKE B. JENSEN, Greenland Fisheries Investigation, 1B, Jaegersborg Allé, DK-2920 Charlottenlund, Denmark.

As the area off West Greenland must be considered as almost unpolluted until now we have an opportunity to establish the natural levels of biogenic hydrocarbons. Examination of the hydrocarbons in invertebrates, fish, and sediments from the West Greenland marine area has been performed by means of gas chromatography and gas chromatography/mass spectrometry. Isolation and identification of the hydrocarbons show that pristane (2,6,10,14-tetramethylpentadecane) and/or squalene (a noncyclic dihydrotriterpene, $C_{30}H_{50}$) were the major components in the analytical material. Three other hydrocarbons were found in smaller quantities, one of which was identified as an n-alkene with the formula $C_{19}H_{38}$. The position of the double bond is supposed to be between C_4 and C_5. Another hydrocarbon showed the formula $C_{20}H_{38}$ and a branched and unsaturated structure. Presumably, the component could be phytadiene (2,6,10,14-tetramethylhexadecadiene), which has previously been found in zooplankton. The last component had an unstable character and showed branched and highly unsaturated structure, suggesting a similarity to squalene. The incidence and the level of the concentration of the biogenic hydrocarbons will be discussed.

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SEASONAL VARIATIONS IN THE FATTY ACID COMPOSITION OF NATURALLY-OCCURRING PARTICULATE MATTER WITH SPECIAL REFERENCE TO THE OCTADECAPENTAENOIC ACID. P. MAYZAUD, Station Zoologique, Villefranche-sur-Mer, France, and R.G. ACKMAN, Environment Canada, Halifax Laboratory, Halifax, Nova Scotia, Canada.

The fatty acid composition of the particulate matter collected in the water of Bedford Basin (Nova Scotia, Canada) has been determined periodically over 6 mo, including the period of the spring bloom of diatoms. On progressing from winter to fall the fatty acid pattern appeared to be characterized by a slightly increasing amount of 16:0 and 18:0, a decreasing amount of 16:1, and a corresponding increase of 18:1. The C_{16} polyenes decreased from 12 to 4% of the total fatty acids whereas the C_{18} polyenes increased from 8 to 21%. The unusual octadecapentaenoic acid (18:5ω3) was present all year round in modest proportions and increased, as the year progressed, from 0.6 to 5% of the total fatty acids. It seemed related to the abundance of dinoflagellates. The occurrence of 18:5ω3 in the lipids of copepods, even at the time of lowest level, confirmed that certain specific fatty acids can be used as food-chain tracers, at least on a qualitative basis.

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THE LIPIDS OF MARINE, CILIATE PROTOZOANS OF THE ORDER SCUTICOCILIATIDA. D.H. BEACH, G.G. HOLZ, and G.G. HOLZ, JR., Department of Microbiology, SUNY, Upstate Medical Center, Syracuse, NY 13210.

The lipids of marine scuticociliatids, collected from open ocean, intertidal and facultative parasite habitats in Massachusetts, Florida, and California have been examined. Total lipids were 5–10% dry wt of three specimens each of *Uronema* and *Parauronema* and one specimen each of *Miamiensis*, *Paraphilaster*, and *Anophrys*. Ciliates were grown in axenic culture, and in monoxenic culture with a gram-negative bacillus, at salinities equivalent to 60–100% seawater. The lipids of a representative form, *Parauronema virginianum* 2/1, were 25% neutral forms (wax esters and sterol esters 5% of total lipids, triacylglycerols 15%, sterols and partial glycerides 5%) and 75% polar forms (choline lipids 18% of total lipids, ethanolamine lipids 40%, acidic lipids 16%, glycolipids 1%). Choline lipids were: diacylglyceryl phosphatidylcholine (11% of total lipids), alkoxy-acylglyceryl phosphatidylcholine (5%), and lyso forms. Ethanolamine lipids were: diacylglyceryl phosphatidylethanolamine (16%), diacylglycerol aminoethylphosphonate (3%), alkoxy-acylglyceryl aminoethylphosphonate (13%), lyso forms and ceramides. Acidic lipids were diphosphatidylglycerol (7%), phosphatidylinositol (7%) and phosphatidic acid. The alkoxy phospho- and phosphonolipids were mainly alkyl forms (glyceryl ethers). Major fatty acids of the total lipids of *Parauronema virginianum* were (% total): 14:0 11.5%, 16:0 8.5%, 16:1 (n-9) 3.4%, 18:0 3.9%, 18:1 (n-9) 17.6%, 18:2 (n-6) 19.5%, 18:3 (n-3) 10.2%, 18:4 (n-3) 13.4%, 20:5 (n-3) 6.1%. The alkoxy-acylglyceryl aminoethylphosphonate was extraordinarily rich in 20:5 (n-3) (62% of total fatty acids).

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IDENTIFICATION OF THE FREE AND BOUND STEROL(S) OF A NON-PHOTOSYNTHETIC DIATOM, *Nitzschia alba*. M. KATES, P. TREMBLAY, and R. ANDERSON, Department of Biochemistry, University of Ottawa, Ottawa, Canada K1N 6N5, and B.E. VOLCANI, Scripps Inst. Oceanography, La Jolla, CA.

Previous studies on the sterol fraction of the non-photosynthetic marine diatom, *Nitzschia alba*, indicated the major sterol to be either brassicasterol (24*R*-methylcholesta-5,22-dien-3β-ol) or 22,25-dehydrocampesterol (24*S*-methylcholesta-5,22-dien-3β-ol) on the basis only of gas chromatography-mass spectral (GC-MS) analysis. Further studies using nuclear magnetic resonance (NMR) and infrared spectrometry and GC-MS on the free and bound sterol fractions isolated by preparative thin layer chromatography (TLC) showed the presence in both fractions of a single sterol, with spectral and chromatographic properties identical with those reported for codisterol (24*S*-methylcholesta-5,25-dien-3β-ol) previously found in the green alga *Codium fragile* [Rubinstein and Goad, *Phytochemistry* 13:485 (1974)]. The 24*S* configuration was confirmed by catalytic hydrogenation (Pd/C) of the *N. alba* sterol acetate to dihydrobrassicasterol acetate (24*S*-methylcholest-5-en-3β-yl acetate). The bound sterol fraction was found to consist of a single compound identified as codisterol sulfate.

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ISOLATION AND STRUCTURE ELUCIDATION OF PHYSIOLOGICALLY ACTIVE FATTY ACIDS FROM MARINE SPONGE *Plakortis* SP. (BV-44). JOGINDER S. CHIB, MARTIN F. STEMPIEN, JR., RONALD A. MIERZWA, and GEORGE D. RUGGIERI, New York Zoological Society, Osborn Laboratories of Marine Sciences, New York Aquarium, Brooklyn, New York, NY 11224 and A.K. BOSE, Stevens Institute of Technology, Hoboken, NJ.

Methanol extracts of the Caribbean sponge *Plakortis* sp. (BV-44) contain a number of antifungal compounds. These were passed through various columns (Amberlite XAD-2, Florisil, Silica gel) to purify and concentrate the active components. Using preparative silica gel thin layer plates, six active lipids have been purified. Spectral analysis (infrared, ultraviolet, nuclear magnetic resonance, mass spectrometry electron impact, mass spectrometry-chemical ionization) of the purified substances indicate them to be homologs containing about 20 carbon atoms. These materials show strong antifungal activity when tested against *Saccharomyces cereviciae* and *Candida albicans*. A crude fraction also showed moderate activity against *Aspergillus niger* and *Trichophyton mentagrophytes* in submerged culture. The isolation and structural elucidation of these compounds will be discussed.

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WAX ESTER DISTRIBUTION IN THE TISSUES OF A SEA ANEMONE, *Metridium senile*. JUDD C. NEVENZEL, Scripps Institution of Oceanography, La Jolla, CA 92093.

From the literature, the occurrence of wax esters in the class Anthozoa (corals, sea pens, sea anemones, etc.) appears to be random, and some discrepancies have been reported. The work reported here with the widely distributed sea anemone *Metridium senile* emphasizes the importance of the biology of these animals to the composition of their lipids. Wax esters are present in *M. senile* only in the female gonads (largely in the eggs, presumably); the wall and other tissues contain no wax esters (i.e., esterified long chain alcohols); and wax esters are not present in any tissue of male animals. The lipid content is high in the female gonads (24% dry wt); their neutral lipids contain major amounts of both wax esters and triglycerides. The former are C_{36} to C_{42} saturated and unsaturated homologs, major components being C_{36} (30%), C_{34} (28%), C_{38} (13%), C_{30} (12%), and C_{32} (11%). About 60% of the total fatty acids of the body wall of this species are C_{20} and C_{22} polyunsaturated homologs. The compositions of the carbon chains of the alcohol and fatty acid moieties of the wax esters and triglycerides of *M. senile* will be presented in detail. The literature on the lipids of Anthozoa will be reviewed briefly in the light of these new findings.

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DEMOSPONGIC ACIDS: UNUSUAL C_{24}-C_{30} FATTY ACIDS FROM MARINE SPONGES. REGINALD W. MORALES, ANNE J. GREENBERG, GREGORY NOTO, and CARTER LITCHFIELD, Biochemistry Department, Rutgers, The State University, New Brunswick, NJ 08903.

Twenty genera of marine sponges from the class Demospongiae were examined for fatty acid composition. All contained unusually high levels (34–79%) of C_{24}-C_{30} n-fatty acids not generally found in other organisms. These characteristic "demospongic acids" were mostly unsaturated, and many contained 2 or more double bonds. Detailed characterization of the demospongic acids from the sponge *Microciona prolifera* revealed a new family of C_{24}-C_{27} polyunsaturated acids with isolated double bonds. All contained Δ5,9 unsaturation. Specific acids identified were: 24:2Δ5,9; 25:2Δ5,9; 26:2Δ5,9; 26:3Δ5,9,17; 26:3Δ5,9,19; 27:3Δ5,9,19; and 27:3Δ5,9,20. Biosynthesis of the prominent 26:2Δ5,9 and 26:3Δ5,9,19 components was studied by following 1-^{14}C-acetate incorporation into all *Microciona* acids and by degradation of the C_{26} unsaturates at their double bonds to locate ^{14}C. Results support the following pathways for biosynthesis: 16:0 →→→ 26:0 → 26:1Δ9 → 26:2Δ5,9 and 16:1Δ9 →→→ 26:1Δ19 → 26:2Δ9,19 → 26:3Δ5,9,19.

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NON-METHYLENE-INTERRUPTED DIENES IN DECAPOD CRUSTACEANS OF THE SOUTHEAST ATLANTIC OCEAN. JEANNE D. JOSEPH and DAVID S. FENDER, Marine Resources Research Institute, PO Box 12559, Charleston, SC 29412.

Non-methylene interrupted dienes (NMIDs) have been observed in lipids of five species of benthic decapod crustaceans (*Penaeus setiferus*, *Penaeus aztecus*, *Callinectes sapidus*, *Menippe mercenaria* and *Hepatus epithelicus*). Two 20-C NMIDs were found at levels of 0.5% or less, but two 22-C NMIDs were present at 3–5% of the total fatty acids in the species investigated. The 22-C NMIDs were isolated from fatty acid methyl esters of the blue crab (*C. sapidus*) by $AgNO_3$ thin layer chromatography (TLC), reduced with hydrazine and the products analyzed by capillary column gas

liquid chromatography (GLC). Two of the three monoenes produced were present in equal amounts and had equivalent chain lengths (ECL) identical with those of 22:1Δ13 (22.32) and 22:1Δ15 (22.41), both of which were present in the original ester mixture. The third monoene, twice as great in amount, had an ECL of 22.24. These results suggest that the 22-C NMIDs have one double bond in common and that their structures are probably the same as those observed in the oyster (22:2Δ7,13 and 22:2Δ7,15), but more definitive studies are necessary to establish the structures unequivocally. Additional data show that the NMIDs are probably of dietary origin in these crustaceans.

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PHOSPHATIDYL INOSITOL ACTIVITY AND ENDOCRINE PRODUCTION IN THE BRAIN OF THE POLYCHAETE, *Nereis virens*. JOAN MARSDEN, Biology Department, McGill University, 1205 McGregor Ave., Montreal, Quebec, H3A 1B1.

Phosphatidyl inositol turnover is known to be high in vertebrate synaptosomes and stimulated secretory tissues. This is also true of the immature brain of the polychaete worm, *Nereis virens*. The immature brain has been shown experimentally to secrete a growth-promoting, sexual differentiation-preventing hormone which is not produced by the brain of the mature worm in which phosphatidyl inositol activity is low. The actual site of hormone elaboration in the brain is unknown. The work reported here is a radioautographic study of six regions of the brain of *Nereis virens* in immature and mature animals. Only one of these regions has been found to have a significantly higher uptake of 3H-inositol in immature animals. Other authors have suggested, on morphological and experimental grounds, that this part of the brain, the ventral glial area, is involved in hormone elaboration and release. This radioautographic study, therefore, provides physiological evidence in support of a concept relating one particular area of the brain of *Nereis virens* to the production of a neurosecretory hormone.

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THE TROPHIC STRUCTURE OF AN ESTUARINE SEDIMENTARY ENVIRONMENT ELUCIDATED BY LIPIDS FROM THE BENTHIC ENDOFAUNA. JAAP J. BOON, W. LIEFKENS, M. BAAS, H. VAN DE SCHOOF, and J.W. DE LEEUW, Delft University of Technology, and P.J. DE WILDE, Netherlands Institute for Sea Research, Delft, The Netherlands.

Lipids from organisms living in a sandy tidal flat area were analysed in an attempt to unravel food relationships. The endofaunal surface feeders *Mya arenaria, Cardium edule,* and *Macoma baltica;* the deposit feeding worms *Arenicola marina* and *Heteromastus filiformis;* the predating worms *Nephtys hombergi* and *Nereis virens;* the sulfate reducing bacterium *Desulfovibrio desulfuricans;* and the sediment surface with living diatoms were investigated. The lipids extracted were surveyed by thin layer chromatography and field desorption mass spectrometry. The products of hydrolysis of the lipid material are separated by chromatographic techniques and analyzed by capillary gas chromatography-mass spectrometry after the appropiate derivatizations. Several groups of characteristic molecules in the investigated organisms are a means to understand their feeding habits. In this way the trophic structure of the sediment is better understood.

74

REVIEW OF PROCESSING COMPANIES' SAFETY PROGRAMS. Roundtable discussion.

Abstract not available at press time.

75

NATIONAL FIRE PROTECTION ASSOCIATION BOOKLET NO. 36—SOLVENT EXTRACTION PLANTS, 1974. J. HEILMAN, Continental Grain Co., New York, NY, and C.L. KINGSBAKER, Dravo Corp., Pittsburgh, PA.

Abstract not available at press time.

76

SAFETY IN EXTRACTION PLANTS FROM THE INSURANCE COMPANY ASPECT. L.J. HALL, Mill Mutual Fire Prevention Bureau, Chicago, IL.

Abstract not available at press time.

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DUST EXPLOSIONS RELATED TO EXTRACTION PLANTS. P.M. BELL, Canadian Vegetable Oil Processing Co., Hamilton, Ontario, Canada, and L.J. HALL, Mill Mutual Fire Prevention Bureau, Chicago, IL.

Abstract not available at press time.

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REVIEW OF KNOWN FIRES AND EXPLOSIONS IN THE SOLVENT EXTRACTION INDUSTRY DURING THE PAST 25 YEARS AND ACTIONS TAKEN TO PREVENT THEIR REOCCURRENCE. *Roundtable discussion.*

Abstract not available at press time.

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SAFETY PROBLEMS NOW PREVALENT IN THE SOLVENT EXTRACTION INDUSTRY. Roundtable discussion.

Abstract not available at press time.

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MARKETING OF TALL OIL PRODUCTS. L.G. ZACHARY, Union Camp Corp., Savannah, GA.

Abstract not available at press time.

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PROCESSING TALL OIL. J. DREW, Sylvachem, Jacksonville, FL.

Abstract not available at press time.

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ANALYTICAL CHEMISTRY USED IN THE TALL OIL INDUSTRY. J. MCBRIDE, Arizona Chemical Co., Wayne, NJ.

Abstract not available at press time.

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APPLICATIONS FOR TALL OIL PRODUCTS. M.J. KELLY, Hercules, Inc., Wilmington, DE.

Abstract not available at press time.

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TALL OIL USED AS CHEMICAL INTERMEDIATES. C.W. BAILEY, Westvaco, New York, NY.

Abstract not available at press time.

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TALL OIL INDUSTRY IN EUROPE. J. NORMAN and J. OXLEY, British Oxygen, England.

Abstract not available at press time.

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CHOLESTEROL AND REPAIR PROCESSES IN ARTERIOSCLEROSIS. H. KAUNITZ, Columbia University, Department of Pathology, College of Physicians and Surgeons, 630 West 168th St., New York, NY 10032.

Some undeniable facts connect cholesterol metabolism with arteriosclerosis: the high cholesterol content of atheromata; the high incidence of heart attacks and strokes among patients with elevated serum cholesterol; the extensive lesions in diseases with high serum cholesterol (nephrosis, myxedema). All of these together with the occurrence of arterial cholesterol deposits in some species fed cholesterol are the main arguments for the lipid theory of arteriosclerosis, which assumes that elevated serum cholesterol levels are atherogenic. Among other things, the theory does not explain why early signs of the disease occur in infants, why early plaques contain no more cholesterol than healthy surrounding tissue, why premenopausal women have fewer heart attacks than men. Many abnormal tissues (scars, tubercles, etc.) contain large amounts of cholesterol along with calcium, collagen, and fibrin as a part of repair processes which can not lead to complete healing. The atheroma contains the same substances, and it is not unlikely that it is also part of repair processes in response to a basic lesion, the nature of which is controversial. This hypothesis leads to different interpretations of the facts on which the lipid theory is based. It also accounts for findings not compatible with the lipid theory, such as the fact that reduction of serum cholesterol by polyunsaturated oils or by drugs is ineffective. Consequences of familial hypercholesterolemia and results of cholesterol feeding to animals ("experimental atherosclerosis") ought not to be used as evidence because they are storage diseases, the natural history of which differs fundamentally from human arteriosclerosis.

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HYPERLIPIDEMIA AND PREMATURE ARTERIOSCLEROSIS. FRANK REES SMLTH, Columbia University College of Physicians and Surgeons, Department of Medicine, Columbia-Presbyterian Medical Center, 630 West 168th St., New York, NY 10032.

The premise that hyperlipidemia and arteriosclerosis are linked is based on both prospective studies in large, free-living populations and on detailed statistical and biochemical studies of smaller populations with familial hyperlipidemia and/or premature myocardial infarctions. The Framingham data demonstrate that the risk of developing coronary artery disease is a statistical function of total serum or low density lipoprotein cholesterol concentration; recent data show an inverse relation as well with high density lipoprotein concentrations. Among patients with genetic hyperlipidemia, children with the rare homozygous form of familial hypercholesterolemia show the clearest relationship between serum lipid elevations and premature coronary artery disease with the onset of arteriosclerosis in the first and second decade and the rare survival beyond the age of thirty. Heterozygous familial hypercholesterolemic individuals also show an increased prevalence of premature arteriosclerosis and early death from myocardial infarction. Three different studies have shown an increased prevalence of premature coronary disease in kindreds with familial combined hyperlipidemia where both or either cholesterol and triglyceride concentrations are elevated in affected family members. Studies of individuals surviving myocardial infarction indicate that 25 to 50% have hyperlipidemia with the hyperlipidemia being more prominent in survivors less than 50 yr of age. Detailed biochemical studies of patients with genetic hyperlipidemias are of great interest in terms of elucidating the link between hyperlipidemia and arteriosclerosis. Recent data obtained with monkeys suggest that hyperlipidemia may in part be responsible for primary endothelial damage and the initiation of the arteriosclerotic process within the artery. Estimates of gene frequencies for the various hyperlipidemias in humans indicate that about one in five patients in the upper 5% in terms of serum lipids have familial hyperlipidemia. Thus, the bulk of the premature arteriosclerosis in our population occurs in individuals with mild to modest elevations of serum lipids in whom the arteriosclerosis is likely a multifactorial process relating to environmental as well as genetic factors. The definitive test of the "lipid hypothesis" will be to show in this larger population that a reduction in serum cholesterol will lead to a reduction in new events of coronary heart disease.

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EPIDEMIOLOGY OF ARTERIOSCLEROSIS IN CHILDHOOD. C.A. NEILL, CMSC 239, The Johns Hopkins Hospital, Baltimore, MD 21205.

Arteriosclerosis is now generally agreed to have its onset in childhood, though clinical manifestations are rare before the third decade of life. Current studies focus on the incidence of hyperlipidemia (both cholesterol and triglycerides) and of essential hypertension, with particular emphasis on families with premature onset of cardiovascular disease in parents or grandparents. Familial hypercholesterolemia can be detected in the first decade of life, and clinical and laboratory data from 100 such families seen in our Lipid Research Clinic will be presented. Familial hypercholesterolemia is only rarely recognized before late in the second decade: data from 20 such families will be presented. Normal cholesterol and triglyceride levels at various ages in several U.S. population samples mostly document a drop of about 10% in cholesterol during adolescence followed by a late rise, while triglycerides rise during adolescence. The current research approaches to arteriosclerosis precursors in childhood and their longterm implications will be briefly summarized.

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THE DEVELOPMENT OF CORONARY THROMBOSIS FOLLOWING MYOCARDIAL INFARCTION. A. WHITLEY BRANWOOD, College of Physicians and Surgeons, Columbia University, 630 West 168 St., New York, NY 10032.

The incidence of occlusive thrombi in coronary arteries in cases of myocardial infarction has varied, depending on the investigator, from 21%–100%. The inescapable conclusion is that in a significant proportion of all cases of acute myocardial infarction, no coronary occlusion is found and when thrombi are present, the infarct is older than the thrombus in a large number of cases. One hundred and twenty-one cases of myocardial infarction were reviewed. Occlusive thrombi were found in 44 cases (35%) and of these, the infarct was older than the thrombus in 30 of these (68%). The factors determining the incidence of thrombi are the length of survival, the size of the heart, the type of infarction, and the presence of cardiogenic shock. These factors are discussed in relationship to the development of thrombosis following myocardial ischemia progressing to necrosis and frank infarction.

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NEURAL FACTORS IN EXPERIMENTAL DEGENERATIVE ARTERIOPATHY. WILLIAM H. GUTSTEIN, and FRITZ PARL, Department of Pathology, New York Medical College, Valhalla, NY 10595.

Intermittent electrical stimulation of the lateral hypothalamus of rats performed for 15 min to 6 hr results in hyperlipidemia and endothelial cell damage of the aorta and coronary arteries. Hyperlipidemia is related to transient biliary obstruction elicited by hypothalamic stimulation and is characterized by elevation of the cholesterol, phospholipid, and triglyceride fractions. Endothelial cell damage is observed ultrastructurally as plasma membrane degeneration with detachment and the formation of large spaces (vacuoles). Thus, neural factors may be implicated in inducing conditions associated with early atherogenesis. Stimulation carried out for longer time intervals would be expected to produce more advanced lesions. However, the role of neural transmission per se (i.e., without hyperlipidemia) in producing arteriopathy is not clearly defined from these experiments. In rats, the lesser splanchnic nerve forms the major innervation of the abdominal aorta. In animals fed normal diets, chronic intermittent stimulation of this nerve (up to 3 wk) resulted in advanced arteriosclerotic changes with intimal fibrosis and calcification. On histologic examination, lipid deposits appeared to be absent from these lesions. Animals stimulated for shorter periods of time exhibited earlier changes associated with atherogenesis, such as endothelial damage, elastic reduplication, and adherent microthrombi. Thus, direct neural transmission, especially if excessive, plays a role in producing arteriopathy. Hyperlipidemia, if persistent, could modify these lesions so that they would accumulate plasma lipids. Experiments to test this hypothesis are currently in progress.

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OVERVIEW. M. WINICK, Columbia University, New York, NY.

Abstract not available at press time.

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APPLICATION OF COMBINED HIGH PRESSURE LIQUID CHROMATOGRAPHY-MASS SPECTROMETRY TO LIPID ANALYSIS. W.H. MCFADDEN, Finnigan Corp., Sunnyvale, CA 94000.

Abstract not available at press time.

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AN IMPROVED SYSTEM FOR INTERFACING LIQUID CHROMATOGRAPHY WITH A FLAME IONIZATION DETECTOR AND MASS SPECTROMETRY. W.L. ERDAHL and O.S. PRIVETT, The Hormel Institute, University of Minnesota, 801 16th Ave. N.E., Austin, MN 55912.

The major problems in the interfacing of liquid chromatography (LC) with a flame ionization detector have been obviated through the development of an improved transport device. Column effluent is added continuously to an endless perforated belt of novel construction that transports the sample continuously as a residue after evaporation of the solvent into a stainless steel sandwich, where it is converted to hydrocarbons in an atmosphere of hydrogen and nitrogen at high temperature. The hydrocarbons are swept into a stack in the sandwich at the exit of which they are combusted in a hydrogen flame. The ion current produced in the reaction is measured as a quantitative analysis of the sample in the effluent from the column. Sensitivity and linearity of the system and its quantitative application are demonstrated with a standard mixture of neutral lipids. For interfacing LC with mass spectrometry, the gaseous stream of hydrocarbons is proportioned and passed into a mass spectrometer operated in the chemical ionization mode. The interface system also provides a novel technique for the direct analysis of high molecular weight lipids by mass spectrometry via single ion monitoring without derivatization. The system is demonstrated by the application to a number of lipids and related compounds.

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LOCATION OF DOUBLE BONDS IN FATTY ACIDS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY. RONALD D. PLATTNER and ROBERT KLEIMAN, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

Unsaturated fatty esters do not produce mass spectra that are useful for determining double bond positions; therefore, suitable derivatives must be made. Several procedures have been used successfully to locate double bonds in monoenoic fatty acid methyl esters, including epoxidation of the double bond, epoxidation followed by reaction with NaI to form ketones, hydroxylation of the double bond to form vicinol diols, and oxymercuration of the double bond with mercuric acetate to form methyl ethers. Epoxy and keto derivatives of polyenes have complex mass spectra which make them unsuitable derivatives. Oxymercurated and silylated hydroxylated polyenes have simpler spectra, but they suffer successive neutral losses [methanol in the methyl ethers and trimethylsilylanol (TNS) in the TMS derivatives of polyols] and, consequently, important diagnostic ions are found in low abundance, if at all. Partial oxymercuration followed by hydrogenation produces a mixture of monomethyl ethers which gives a spectrum with intense and easily recognized ions for all double bond positions. The spectra of N-acylpyrrolidide derivatives of fatty acids have been used for determination of double bond position while keeping the double bonds intact. The important ions used to determine the position of the double bond have low abundances, making confident interpretation of unknowns difficult.

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THE PYRROLIDIDE DERIVATIVE. THE IDEAL CHOICE FOR THE LOCATION OF SUBSTITUENT GROUPS IN FATTY ACIDS. ANTHONY J. VALICENTI, WAYNE H. HEIMERMANN, and RALPH T. HOLMAN, The Hormel Institute, 801 16th Ave. N.E., Austin, MN 55912.

The pyrrolidide derivative of a fatty acid, prepared by the reaction of pyrrolidine with the methyl ester or triglyceride of a fatty acid, has been found to be of nearly universal utility in the location of substituent groups in fatty acid chains. Unlike derivatization at the substituent group, pyrrolidization at the carboxyl group guarantees quantitative derivatization, regardless of the number or type of substituent groups present in the fatty acid. The technique does not require the isolation of components of a sample prior to analysis, since the derivative is sufficiently volatile to permit gas chromatography-mass spectrometry (GC-MS) analysis of a mixed fatty acid sample. Using this method, we have successfully obtained the entire positional analysis of fatty acids from biological samples in one GC-MS analysis. The technique has been used for the location of the double bonds in polyenes, triple bonds, cyclopropyl groups, methyl groups, hydroxy, keto, deuterium, and other substituents. Because the amide moiety is stable under electron impact (70 ev), intense ions containing the polar end of the molecule predominate. Thus, simple spectra are obtained in which the position of substituent groups may be deduced directly without necessitating a library search. Representative spectra will be presented and discussed.

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MASS SPECTRAL ANALYSIS OF UNSATURATED OXYGENATED FATTY ACIDS. ROBERT KLEIMAN and RONALD D. PLATTNER, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

The identification and characterization of novel oxygenated fatty acids, isolated from plant materials or produced in lipid oxidation reactions, have been greatly assisted by combined gas chromatography-mass spectrometry. The location of hydroxy, epoxy, or keto functional groups in saturated, olefinic, and acetylenic fatty esters can be deduced from mass spectral fragmentation patterns. Trimethylsilyl ether derivatives of hydroxyl groups produce simple spectra with intense ions that are used to locate the oxygenated carbon. Epoxy groups are located from fragmentation patterns obtained after the oxyrane ring is opened with BF_3-methanol or acetic anhydride, followed by silylation of the resulting hydroxyl groups. Although complex polyfunctional esters, like epoxy-hydroxy and keto-hydroxy monoenes, produce complex spectra, they can be interpreted by analogy with the simpler monofunctional esters. Acetylenes can be reacted with mercuric acetate in methanol and reduced with sodium borohydride to produce hydroxy esters that pinpoint the location of this unsaturation.

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GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC ANALYSIS OF NATURALLY-OCCURRING LIPID ODOR COMPONENTS. RALPH T. HOLMAN, WAYNE HEIMERMANN, and A.J. VALICENTI, The Hormel Institute, 801 16th Ave. N.E., Austin, MN 55912.

Odors of biological origin which are physically related to lipids were collected in small quantities by a dry method which can be easily used in the field. Samples can be stored or transported without significant loss, and the odors can be liberated in a special sample port of a gas chromatograph. Gas liquid chromatographic (GLC) analyses were made of such samples, and mass spectra of the separated components tentatively identified them. The quantitative composition of the floral odors of magnolia were used as the basis of species-species comparisons, leading to quantitative expression of relationships and pseudo-three dimensional graphic presentations of the interspecific relationships of the genus. Similar studies were made in several species of a few genera of orchids. The sampling technique has also been used to characterize the volatile oxidation products from methyl esters of positional isomers of all-*cis* polyunsaturated acids. By this GLC-MS approach, the analysis of the products clearly distinguished the differences in structure of the original esters. The application of the method to other problems related to foods and biology will be illustrated and discussed.

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COMPARATIVE STUDIES ON MOLECULAR SPECIES OF SPHINGOLIPIDS IN MARINE ANIMALS. AKIRA HAYASHI and FUMITO MATSUURA, Department of Chemistry, Faculty of Science and Technology, Kinki University, Kowakae, Higashiosaka, 577 Japan.

At the Symposium on "Lipids of Marine Invertebrates" of this Society's Meeting in Ottawa, 1972, the authors reported the distribution and structures of sphingophosphonolipids in some marine shellfishes. In the present paper, the molecular species of cerebrosides obtained from nine species of marine animals—seven species of Mollusca (Loricata, Gastropoda, and Pelecypoda), one species of Arthropoda, and one Echinodermata—were determined with combined gas chromatograph-mass spectrometer (GC-MS) to elucidate the relation between the molecular species of sphingolipids and the animal diversity (classification evolution, etc.). In some species, molecular species of cerebrosides in each organ—such as adductor, gills, mantle, and viscera in oyster—were also analyzed. The molecular species of sphingophosphonolipids including a newly found phosphate derivative of cerebroside in Gastropoda were analyzed and compared with those of cerebrosides. Sphingolipids were purified and isolated by repeated column chromatography and thin layer chromatography after mild alkaline hydrolysis of chloroform-methanol extracts from fresh tissues. Cerebrosides were trimethylsilylated and applied to GC-MS using electron impact ionization method. GC-MS using chemical ionization was also carried out to obtain the accurate information of molecular weight. The analysis of the hydrophilic part of sphingolipids after their methanolysis showed many interesting results in cerebrosides: galactose is the only sugar component in Loricata, some Gastropoda, and Arthropoda; however, glucose is the main component in Pelecypoda and especially in Echinodermata which belongs to the same branch in the phylogenetic tree as vertebrates. The data obtained from the molecular species of ceramide moiety (hydrophobic part of sphingolipids) also revealed many characteristic features in the aspects of bio-

synthetic pathway of sphingolipids and of the role of sphingolipids in the biomembrane of marine animals.

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FATTY ACIDS AND STEROLS OF THREE MICROSPORIDIA PARASITES IN *Carcinus mediterraneus* (CRUSTACEA, BRACHYURA) AND FATTY ACIDS OF THEIR HOST, HEALTHY AND CARRYING PARASITES. BERNARD J. MARTIN, CHRISTIAN P. VIVARES, and HUBERT CECCALDI, Ecole Pratique des Hautes Etudes, Station Marine d'Endoume, Rue de la Batterie des Lions, 13007 Marseille, France.

The composition of the fatty acids of three Microsporidia: *Telohania maenadis* Perez, 1904; *Nosema pulvis* Perez, 1905; and *Ormieresia carcini* Vivares, Bouix et Manier, 1976, parasitizing the crab *Carcinus mediterraneus* Czerniavsky, 1884, have been established. Certain fatty acids show large differences from one species to another. Thus, the 18:2ω6 attains a level of 44% of the total fatty acids in *N. pulvis*, whereas it represents ca. 1% of the total fatty acids in the other two species. The sterols identified in the Microsporidia are, among others, cholesterol; 24-norcholesta-5,22-dienol; asterosterol; β-sitosterol; and spinasterol, in varying proportion in the three species. The muscle composition of the crab carrying the parasite *T. maenadis* shows noticeable differences from those of a healthy crab, particularly for the 18:2ω6, 18:3ω6, 20:3ω6, 20:5ω6, 20:4ω6, and 20:3ω3. For the same crab, differences in the composition of the fatty acids of the total haemolymph can be seen for the 18:1ω9, 18:2ω6, 20:2ω6, 20:4ω6, and 22:6ω3.

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SERUM LIPOPROTEINS OF THE BLUE CRAB *Callinectes sapidus*. RICHARD F. LEE and SARA SINGER, Skidaway Institute of Oceanography, PO Box 13687, Savannah, GA 31406.

The lipid concentration of the whole serum was between 50 and 70 mg of lipid per 100 ml of serum. The lipid was transported on a high density lipoprotein falling in the density range 1.12–1.21 g/ml. The major lipid types were phospholipid (82%), cholesterol (4%), and triglyceride (9%) with only traces of diglycerides and cholesterol esters. The phospholipid fraction consisted on phosphatidyl choline (90%), phosphatidyl ethanolamine (6%), sphingomyelin (3%), and lysophosphatidyl choline (2%). The 20:5 and 22:6 accounted for 14 and 11%, respectively, of the phospholipid fatty acids but were only minor components in the triglyceride accounting for 4 and 1%, respectively. The results of feeding with ^{14}C-triglycerides suggested that the lipoproteins were formed in the hepatopancreas of the crab. The high density lipoprotein of the blue crabs show similarities to the high density lipoproteins of the horseshoe crabs, insects, hagfish, and humans with a deficiency of the enzyme lecithin:cholesterol acyltransferase.

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DISTRIBUTION, STRUCTURE, AND POSSIBLE PHYSIOLOGICAL FUNCTION OF SAPONINS IN THE STARFISH *Asterias rubens*. P.A. VOOGT, Laboratory of Chemical Animal Physiology, State University of Utrecht, Transitorium III, Padualaan 8, Utrecht, The Netherlands.

Saponins are common in plants, but in animals they are very rare and nearly exclusively restricted to echinoderms. Within this phylum they are found only in those classes in which the sterols are of the Δ^7-type, that is, the Asteroidea (starfishes) and the Holothuroidea (sea cucumbers). However, their saponins are quite different, because in the starfishes they are derived from pregnane and cholestane, whereas in the sea cucumbers they are derived from triterpenoids. We have found saponins in the skin, pyloric caeca, and gonads of *Asterias rubens*. The composition may be somewhat different for these organs. They are nearly absent in the testes, whereas their concentration in the ovaries shows an annual cycle. In the ovaries they are localized within the oocytes, where they make up over 10% of the dry weight of the oocyt contents. The sugar moiety of the asterosaponins consisted mainly of quinovose and fucose; mannose, glucose, and xylose were minor components. Thin layer chromatography (TLC) of the aglycons gave three spots. One of them consisted of only two components, both of the C_{21}-type. The other spots turned out to consist each of a rather complex series of steroids. The composition of the aglycons from the ovaries is more simple than the composition of those from the pyloric caeca, as the main series consisted only of two components, both of the C_{27}-type. The possible functions of asterosaponins in the ovary are discussed with respect to their suggested inhibitory effect on mitosis, meiosis, and spawning.

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SEASONAL VARIATIONS IN THE LIPIDS OF TWO AMPHIPOD SPECIES, *Gammarus lacustris* G.O. Sars and *Hyalella azteca* Saussure. M. YURKOWSKI and JO-ANNE L. TABACHEK, Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba R3T 2N6, Canada.

The contents and fatty acid composition of total lipids (TL), total neutral lipids (NL), and total phospholipids (PPL) and content of carbohydrates, chitin, ash, and moisture were determined in two amphipod species, *Gammarus lacustris* and *Hyalella azteca* taken from two saline lakes in Manitoba at monthly intervals where possible. The content of TL, NL, and PPL reached the maximum in the spring and the minimum in the winter. The ash and chitin content, opposite to carbohydrate content, was the highest in the summer and the lowest in the winter. The average fatty acid composition of the two amphipods, except for minor differences, was quite similar even from different lakes. The major fatty acids (over 10%) were 16:0, 16:1, 18:1, and 20:5ω3 in the TL and NL, and 16:0, 18:1, and 20:5ω3 in the PPL. Those between 5 and 10% were 18:2 and 18:3ω3 in all three lipids as well as 20:4ω6 in TL and PPL and 22:6ω3 (only in *G. lacustris*) in PPL. The maximum level of total saturated acids (constant in TL and NL of *H. azteca*) and total monoenoic acids was reached in the spring and/or summer and the minimum in the fall and/or winter. The level of total ω6 acids and total ω3 acids appeared to reach the maximum in the fall and/or winter and decreased to the minimum with spring or summer.

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LIPIDS OF THE EGG, HATCHLING, AND ADULT OF *Fundulus heteroclitus*. CLAUDIA F. BAILEY, Department of Zoology, University of Arkansas, Fayetteville, AK 72701.

The eggs of *Fundulus heteroclitus*, an estuarine teleost, display a unique variety of lipids which are associated with energy metabolism and which serve as a source of molecules for membrane biogenesis in the developing embryo. Chemical assays and combined chromatographic techniques reveal a complex spectrum of lipids significantly different from that of the embryo or adult. Neutral lipids, mainly triglyceride and cholesterol, predominate in the egg. Smaller amounts of cholesterol esters and hydrocarbons are also present. The fatty acids are characteristic of teleost tissues, and of marine organisms in general, extending through the entire range of saturated fatty acids from C_{12} to C_{20} and unsaturated forms of C_{16} to C_{24}. Phosphatidyl ethanolamine and phosphatidyl choline are the major phospholipids. Qualitative and quantitative data from the adult and hatchling show a lipid composition more consistent with and reflecting the structural nature of membrane systems in differentiated cells. Phospholipids are the principal components in these stages while neutral lipid fraction contains mainly cholesterol. Although there is less variety among the fatty acids, more long chain acids are present.

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SEASONAL VARIATIONS IN THE LIPIDS OF FATHEAD MINNOWS (*Pimephales promelas* Rafinesque) AND BROOK STICKLEBACK (*Culaea inconstans* Kirtland). M. YURKOWSKI and JO-ANNE TABACHEK, Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba R3T 2N6, Canada.

The content and fatty acid composition of total lipids (TL), neutral lipids (NL), and phospholipids (PPL), content of carbohydrates, ash and moisture were determined in two fish species, *Culaea inconstans* and *Pimephales promelas*, taken from two saline lakes in Manitoba at monthly intervals where possible. The TL and NL content reached the maximum in the summer and the minimum in the winter. The PPL (little change in *P. promelas*) content was the highest in spring during spawning. Ash content tended to be the highest in early spring and lowest in late summer; constant in *P. promelas* (no data for spring). The carbohydrate and moisture (only in *C. inconstans*) content was the highest in the winter and lowest in the summer. The average fatty acid composition of the lipids from the two fish species was quite similar even from different lakes. The major fatty acids (over 10%) were 16:0, 16:1 and 18:1 in the TL and NL, and 16:0, 18:1, 20:5ω3 and 22:6ω3 in PPL. Those between 5 and 10% were 18:3ω3, 20:5ω3 and 22:6ω3 in the TL; 18:2, 18:3ω3 and 20:5ω3 in the NL; and 16:1, 18:0, 20:4ω6 and 22:5ω3 in the PPL. The level of total saturated and total monoenoic acids seems to be constant in *P. promelas* and reached a maximum in the late summer in *C. inconstans*. The level of total ω6 acids in *P. promelas* appeared to reach the maximum in the summer and decreased to the minimum in the fall and winter, but in *C. inconstans* the level reached the minimum in the summer and increased to the maximum in the winter. The maximum level of total ω3 acids was reached in the summer and the minimum in the winter.

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LUNG SURFACTANT SYNTHESIS IN AIR-BREATHING FISHES. CHARLES F. PHLEGER, Department of Physical Science, San Diego State University, San Diego, CA 92182.

The synthesis and distribution of lung (or swimbladder) surfactant phospholipids was examined in a series of Amazon fishes spanning the gap from obligate water respiration (*Hoplias malabaricus*) to obligate air-breathers (*Lepidosiren paradoxa* and *Arapaima gigas*). Two facultative air-breathers were also studied: *Hoplerythrinus unitaeniatus* and *Erythrinus erythrinus*. *Lepidosiren* and *Arapaima* are very close with regard to lung surfactant synthesis (87% acetate-1-C^{14} incorporation into phosphatidylcholine) in contrast to the other three species (8–31%). Lung metabolism (as cpm/mg lipid after incorporation of acetate-1-C^{14}) increased stepwise from *Hoplias* to *Lepidosiren* with an increase in air-breathing capacity. Gill phospholipids and metabolism of these fishes did not show marked between-species differences, except in *Hoplias*. Lung surfactant synthesis appears to correlate well with development of air-breathing in these fishes, but the gills do not change appreciably in their capacity to synthesize phospholipids despite a loss in respiratory function.

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EFFECT OF DIETARY CHOLESTEROL ON OYSTERS, *Crassostrea virginica*. DON J. TRIDER and JOHN D. CASTELL, Environment Canada, Resource Branch, PO Box 429, Halifax, Nova Scotia B3J 2R3.

Artificial diets differing in their lipid composition were fed to oysters for a period of 30 wk. The various diets contained corn oil, cod liver oil, a combination of corn and cod oil, hydrogenated coconut oil, ethyl esters of cod oil (sterol free), and ethyl esters of cod oil plus 1% cholesterol. Animals fed diets containing whole cod oil gave the best growth response. Oysters fed the sterol free and cholesterol supplemented diets showed a growth response significantly lower than the cod oil fed animals. The sterol supplemented animals did not have a total cholesterol content higher than animals fed whole cod oil. The cholesterol supplemented animals did exhibit a unique feature in the neutral fraction of the total lipid. These oysters had levels of palmitic acid three times lower and levels of 20:1ω7 three times higher than animals from other dietary treatments. It appeared that the additional cholesterol in the diet had affected normal metabolism and that 20:1ω7 was being synthesized to cope with the excess sterol. A labelling study showed that oysters fed cod liver oil and cod oil ethyl esters, supplemented, and nonsupplemented, were not synthesizing sterol from ^{14}C-acetate.

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LIPID METABOLISM OF CULTURED AND WILD ATLANTIC SILVERSIDE (*Menidia menidia*): THE FATTY ACID COMPOSITION OF THE TOTAL LIPIDS AND POLAR AND NEUTRAL LIPID CLASSES. PAUL S. SCHAUER, ALAN D. BECK, and KENNETH L. SIMPSON, Dept. of Food Science and Technology, University of Rhode Island, Kingston, RI 02881.

A feeding study was undertaken in the summer of 1975 to assess the relationship of the whole body fatty acids of wild versus cultured Atlantic Silversides (*Menidia menidia*) fed the common brine shrimp, *Artemia salina*, and a commercial salmon diet (soybean oil). This study showed wild silversides to have a high level of ω3 long chain polyunsaturated fatty acids (PUFA) exemplified by an ω3/ω6 ratio of 11.28. *Artemia*-fed silversides had a marked reduction in the longchain PUFA with a concomittant increase in the C_{18}

fatty acids and resulted in an $\omega3/\omega6$ ratio of only 1.5. Although the growth and survival in the *Artemia* fed group was better than the salmon-diet fed group neither diet provided adequate dietary character. Results indicated that a balanced ratio of the $\omega3/\omega6$ type fatty acids may be necessary for effective lipid metabolism and that a marine type oil may be required to provide the proper dietary fatty acids. In 1976, studies were undertaken using *Artemia*, other potential diets, and a lipid modified salmon diet (cod liver oil). In addition to determining the fatty acid spectrum of the diets and the fish's whole body fatty acid spectrum, polar and neutral lipid classes were also analyzed. These results will be discussed in relation to how dietary fatty acids are ultimately utilized or deposited and how various diets effected the fatty acid constituents of the structural and storage type tissues.

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EFFECT OF DIETARY FATTY ACIDS OF DIFFERENT CHAIN LENGTHS AND SERIES ON THE GROWTH OF TURBOT *Scophthalmus maximus* L. C. LEGER, J.F. GATESOUPE, and P. LUQUET, Station de Recherches de Nutrition, Centre National de Recherches Zootechniques, 78350, JOUY-en-JOSAS, France, and R. METAILLER, Centre National pour l'Exploitation des Océans, France.

The growth of turbot was improved when the dietary content of $\omega3$ (polyunsaturated fatty acid) L-PUFA (C > 20 PUFA) was increased from 0 to 0.57 g/100 g dry food. This growth was not further improved when the L-PUFA diet content was increased from 0.57 to 1.43 g/100 g. On the other hand growth was not improved when the C18:3$\omega3$ content was raised from 0 to 0.55 g/100 g, provided $\omega3$ L-PUFA were absent from the diet. According to these results turbot have a specific requirement for the $\omega3$ L-PUFA since an equivalent amount of C18:3$\omega3$ did not lead to the same growth performance. Either the fish did not possess the enzymes necessary for these reactions, or the elongation-desaturation rate from C18:3$\omega3$ to L-PUFA was not adequate. Subsequently, the turbot were fed diets containing either $\omega3$ L-PUFA (0.74 g/100 g dry food) without C18:3$\omega3$, or C18:3$\omega3$ (from 0.55 to 3.7 g/100 g dry food) without $\omega3$ L-PUFA. The best growth characteristics were obtained with animals receiving the first type of diet, but the diets containing a high level of C18:3$\omega3$ without $\omega3$ L-PUFA gave a better growth rate than those containing a lower level of C18:3$\omega3$. This suggests that the turbot, like trout, might be able to use the C18:3$\omega3$ precursor of the $\omega3$ series, but that the enzymatic elongation-desaturation capacity might be lower either because of slow reaction rates or an inadequate synthesis of the enzymes required to catalyse the reaction. Alternatively the physiological requirements of the turbot for $\omega3$ acids could be larger than those of the trout. Although a diet containing 1% C18:3$\omega3$ gave a normal growth in the trout (Yu, Sinnhuber, 1972), our results show that 4% is probably the minimal quantity required for the turbot. We also noticed that $\omega9$ L-UFA, as in other vertebrates, might exhibit a depressant effect on the growth of turbot. Analyses of FA and various classes of lipids will be discussed.

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COMPOSITIONAL TOPOGRAPHY OF MELON LIPIDS IN THE PYGMY SPERM WHALE *Kogia breviceps*: IMPLICATIONS FOR ECHOLOCATION. ROBERT KAROL and CARTER LITCHFIELD, Department of Biochemistry, Rutgers, The State University, New Brunswick, NJ 08903.

The forehead of the pygmy sperm whale *Kogia breviceps* contains a large "melon" of fatty tissue in front of a small, fat-filled, cornucopia-shaped spermaceti organ. This unique anatomical structure may possibly play an acoustical role in the animal's echolocation system, similar to the fatty "melon" sound lens postulated for dolphins. To better understand its function, we have studied the compositional topography of the *Kogia* melon and spermaceti organ lipids. The fatty tissue of an adult *Kogia* was serially sectioned into nine transverse slices. Appropriate tissue samples were cut from every other slice and analyzed for % lipid and lipid class composition. Wax esters and triglycerides were the only major lipids present: their average carbon number in each sample was determined by gas liquid chromatography (GLC). Our topographical analyses of *Kogia* melon indicate three regions of distinctive lipid composition: a fat-poor melon exterior, an "outer melon" of medium fat content where % triglyceride > % wax ester, and a fat-rich "inner melon" where % wax ester > % triglyceride. The spermaceti organ contains a fat-rich core of very high wax ester content (84%) surrounded by a fat-poor case. Average carbon numbers of both wax esters and triglycerides were lowest in the inner melon and the spermaceti organ. These data together with anatomical and acoustical considerations suggest that the *Kogia* melon/spermaceti organ system could function as an acoustical transducter for transmitting sound waves for echolocation.

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BIOSYNTHESIS OF BRANCHED CHAIN FATTY ACIDS IN ADIPOSE TISSUE OF THE DOLPHIN. HIDEAKI MORII, Faculty of Fisheries, Nagasaki University, 1-14 Bunkyo-machi, Nagasaki, Japan, and TAKASHI KANEDA, Faculty of Agriculture, Tohoku University, Sendai, Japan.

In order to ascertain the origin and the function of the branched chain fatty acids in dolphin oil, radioactivities of $^{14}CO_2$ metabolized from Leucine-, Isoleucine-, and Valine-U-^{14}C and of ^{14}C incorporated into lipids were determined by liquid-scintillation spectrophotometry, and incorporation of ^{14}C into fatty acids was analysed by radio gas liquid chromatography using tissue slices of adipose tissue, liver, and muscle in *Stenella caeruleo-alba*. In the fatty acids of glycerides from melon, the fatty acids synthesized were iso 5:0, 11:0, 13:0, and 15:0 from Leucine-U-^{14}C; anteiso 5:0, 11:0, 13:0, and 15:0, and normal 11:0–16:0 from Isoleucine-U-^{14}C; and iso 4:0, 12:0, 14:0, and 16:0 from Valine-U-^{14}C; and these fatty acids were similar in composition to the fatty acids of dolphin oil. In the fatty acids of glycerides from the blubber, the fatty acid synthesized was iso 5:0 from Leucine-U-^{14}C, with no longer chain branched fatty acids, and instead, normal 12:0, 14:0 and 16:0 were synthesized. Radioactivities of ^{14}C incorporated into lipids in liver and muscle were extremely low as compared with those of adipose tissue. The value of lipid-$^{14}C/^{14}CO_2$ in every branched chain amino acid-U-^{14}C was higher in adipose tissue than in liver and muscle, and especially the value from Leucine-U-^{14}C in melon was quite high. In addition, incorporation of ^{14}C into glycerol in glycerides, and into short- and long chain fatty acids and fatty alcohols in wax esters was recognized throughout all the amino acid-U-^{14}C studies.

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THE APPLICATION OF GAS CHROMATOGRAPHY-MASS SPECTROMETRY IN FLAVOR RESEARCH. DAVID B. MIN, Best Foods Research Center, CPC International, 1120 Commerce Ave., Union, NJ 07083.

The use of combined gas chromatography with mass spectrometry has been proven as one of the most powerful tools for fast, specific separation and for the characterization of compounds present in complex flavor systems. This paper will present a review of gas chromatography-mass spectrometry applications on the study of the chemical reaction products of flavor compounds during storage and their flavor impacts on the final product. This paper will also review the study of the mechanism of formation of flavor compounds in roast beef and the transport of residual compounds from packaging materials to the enclosed food products and the effect of the transferred compounds on the product.

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INSTRUMENTAL ANALYSIS OF RESIDUAL SOLVENT AND FLAVOR QUALITY OF SOY PROTEIN PRODUCTS. E.T. RAYNER, J.I. WADSWORTH, M.G. LEGENDRE, and H.P. DUPUY, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

A simple, direct, gas chromatographic technique is described for eluting and resolving residual solvent and flavor-related volatile components from soy protein products such as flour, concentrate, and isolate. No prior enrichment of volatiles is necessary. A sample is secured in the injection port liner of a standard gas chromatograph together with a small quantity of water. The volatiles are rapidly steam distilled and eluted in situ. Residual solvent and other volatiles are effectively resolved by temperature programmed gas chromatography and characterized by combined gas chromatography-mass spectrometry. The correlation between taste panel flavor score and concentration of volatile components is significant at the 1% level.

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ELECTRON SPIN STUDY OF THE PATHWAY OF THE REACTION BETWEEN OXIDATION PRODUCTS OF UNSATURATED OILS WITH PROTEINACEOUS MATTER. FRANCISKA SUNDHOLM and ANNELI VISAPÄÄ, University of Helsinki, Finland, and JOHAN BJORKSTEN, Bjorksten Research Foundation, Route 4, Box 9444, Madison, WI 53715.

These studies were carried out using model systems of unsaturated oils suspended in gelatin or pre-collagen gels. The progress of crosslinking, when this occurred, was indicated by progressive increases in melting points from 50 C to 100 C, in the presence and abscence of free radical scavengers and of ascorbic acid as a reducing agent. No sign of paramagnetism could be detected in the films using a Varian E-3 spectrometer at temperatures between +100 C and −150 C with variation of all the measuring parameters. The addition of nitroxyl forming radical scavengers decreased the rate of crosslinking. The conclusion is drawn that the main reaction in the crosslinking reaction of collagen related proteins is a condensation of amino groups and extrinsic or intrinsic carbonyl groups. The extrinsic aldehydes are formed in the autoxidation of unsaturated lipid.

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FLAVOR AND OXIDATIVE STABILITY OF HYDROGENATED AND UNHYDROGENATED SOYBEAN OIL. EFFECTS OF ANTIOXIDANTS. T.L. MOUNTS, K. WARNER, G.R. LIST, J.P. FRIEDRICH, and S. KORITALA, Northern Regional Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604.

Flavor and oxidative stability of soybean oil, unhydrogenated and hydrogenated, has been studied by organoleptic evaluation and chemical analysis. Soybean oils (I) unhydrogenated (IV = 137.7, % linolenate = 8.3), (II) hydrogenated with nickel catalyst (IV = 109.1, % linolenate = 3.3), and (III) hydrogenated with copper-chromium catalyst (IV = 112.8, % linolenate = 0.4) were each deodorized with the addition of either citric acid only or citric acid plus butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) antioxidants. The oils were evaluated after being subjected to accelerated storage tests (4 day and 8 day) and fluorescent light exposure test (4 hr). Oxidative stability was measured by 8-hr Active Oxygen Method procedures and peroxide value determinations at the time of organoleptic evaluation. The flavor stability of (I) was not enhanced by the added antioxidants under any of the test conditions. Added antioxidants improved the flavor stability of (II) in both accelerated storage and light exposure tests. In the light exposure test the flavor stability of (III) was increased by added antioxidant. There was no significant enhancement of the flavor stability of soybean oil by hydrogenation alone. With added antioxidants the flavor stability of (II) and (III) relative to (I) was significantly increased in the 8-day accelerated storage test. Oxidative stability, as measured by the Active Oxygen Method, was improved by both hydrogenation and added antioxidants. Oxidative stability, as measured by peroxide value, was not affected by added antioxidants; however, it was significantly improved by hydrogenation.

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ANALYSES OF AUTOXIDIZED FATS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY. METHYL LINOLENATE. E.N. FRANKEL, W.E. NEFF, and W.K. ROHWEDDER, Northern Regional Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604, and B.P.S. KHAMBAY and B.C.L. Weedon, University of London, London, England.

Gas chromatography-mass spectrometry (GC-MS) was investigated as a direct method to analyze autoxidized natural fats that include mixtures of oleate, linoleate, and linolenate. We used this approach previously to analyze the isomeric hydroperoxide composition of autoxidized oleate, linoleate, and different mixtures of these esters [determined as the oxygen trimethylsilyl (OTMS) ethers of the hydroxystearate derivatives]. This work has now been extended to linolenate and its mixtures with oleate and linoleate. With autoxidized linolenate, the proportion found of 9- and 16-hydroperoxides was significantly higher (70–79%) than the 12- and 13-hydroperoxides (21–30%). This isomeric distribution reflects either the relative instability of the internal 12- and 13-hydroperoxides or their tendency to cyclize into prostaglandin-

like endoperoxides [Pryor et al., *Lipids* 11:370 (1976)]. The GC-MS approach has made it possible for the first time to determine the origin of the hydroperoxides formed in mixtures of unsaturated fatty esters. With equal mixtures of esters autoxidized at levels below 10%, the proportion of linolenate hydroperoxides was only slightly greater than linoleate hydroperoxides but much greater than oleate hydroperoxides. With autoxidized mixtures containing only 10% linolenate, the proportion of hydroperoxides originating from linolenate was considerably greater.

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TERTIARY BUTYLHYDROQUINONE ANTIOXIDANT IN FOOD FRYING OILS. E.R. SHERWIN, Eastman Chemical Products, Inc., PO Box 431, Kingsport, TN 37662.

Tertiary butylhydroquinone (TBHQ) antioxidant added to vegetable oil used to fry foods, such as potato chips, may result in improved shelf life of the fried food as long as the antioxidant content of the oil in the fryer remains high enough. However, this effect is diminished substantially or even eliminated in a food frying operation when the antioxidant content of the oil in the fryer is reduced by the distillation and vaporization losses which occur during frying. This paper reviews test results showing how increased concentrations of the antioxidant in the "make-up" oil in continuous frying serves to compensate for the losses and increases shelf life of the fried food. Also, some correlations between stability values of the fried food and the frying oil, compared with the antioxidant content of the frying oil, are presented.

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A COMPREHENSIVE COMPARISON OF THE OXIDATIVE AND FLAVOR STABILITIES OF SUNFLOWER OIL VS. CORN OIL. (HONORED STUDENT PRESENTATION). AN-SHUN HUANG, OLIVER HSIEH, and STEPHEN S. CHANG, Department of Food Science, Cook College, Rutgers, The State University, PO Box 231, New Brunswick, NJ 08903, and CHENG-LI HUANG, Pharmacia, Inc., Piscataway, NJ.

A northern sunflower oil was comprehensively evaluated against a corn oil. The sunflower oil was tested before and after winterization, as well as with and without antioxidants. The corn oil was tested after winterization with and without the addition of methyl silicone. Under normal use conditions at room temperature and 35 C, in the presence of air in the headspace gas, sunflower oil developed peroxides more rapidly than corn oil. However, these higher peroxide numbers did not seem to affect its organoleptic scores. Starch chunks, deep-fat fried in corn oil, had better flavor stability than those fried in sunflower oil. The peroxide values of the corn oil-fried starch chunks were consistently lower than the sunflower oil-fried starch chunks at various stages of aging. Oil samples deep-fat fried with moist cotton balls for periods of one day and five days did not show any significant difference in odor strength, odor preference, flavor strength, and flavor preference when evaluated organoleptically. Gas chromatographic analysis of the volatiles isolated from the oils used for the simulated deep-fat frying for one day showed a large number of volatile compounds, in relatively large amounts. The amounts were not proportionally increased after 5 days of frying if fresh oil was used at the beginning of each day to replenish the oil absorbed by the cottonballs. The volatiles isolated from used sunflower oil and corn oil showed different chromatograms. Corn oil appeared to have fewer volatiles than sunflower oil. The addition of methyl silicone showed a decrease in the amount of volatiles. During the simulated deep-fat frying, there was a decrease in iodine value and tocopherols. There was also an increase in viscosity, non-urea-adduct-forming esters, and color. The increase or decrease was a measure of the degree of deterioration during frying. In general, corn oil appeared to have more deterioration than sunflower oil if no additive was used. With the addition of methyl silicone and antioxidants, corn oil appeared to have less deterioration than sunflower oil.

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EFFECTS OF THERMALLY OXIDIZED CORN OIL ON THE LIPID COMPOSITION AND METABOLISM OF IN VITRO HEART CELLS. J.C. ALEXANDER and RANJANA PRASAD BIRD, Department of Nutrition, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

There have been several reports that thermally oxidized fats can be toxic to experimental animals. Components which are concentrated in the distillable non-urea adductable fraction (DNUA) are absorbed and deposited in body tissues. Histopathological changes have been seen in certain organs. The mechanism of toxicity has not been established. Commercially available corn oil was heated at 180 C for 72 hr with 8 hr of aeration during each of the 3 days, and the free fatty acid portion of the DNUA fraction was isolated. The control fat was the free fatty acid fraction from fresh corn oil. In vitro heart cells from neonatal rats were used as a model system. The DNUA fraction of the heated fat produced lipidosis, vacuolization of the cytoplasm, and nuclear pyknosis. The mitotic activity of these cells was decreased significantly, while the total protein content was increased. The triglyceride and phospholipid fractions from heart muscle and endothelial cells had lower levels of linoleic acid and arachidonic acid. There was a significantly greater incorporation of $1\text{-}^{14}C$-palmitate into the triglyceride fractions. Components of DNUA from thermally oxidized fat produced effects at the metabolic level with increased lipogenic activity of the cells.

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SELECTIVE HYDROGENATION OF SOYBEAN OIL. VIII. EFFECT OF METHOD OF PREPARATION UPON THE ACTIVITY OF A COPPER-SILICA CATALYST. S. KORITALA, Northern Regional Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604.

A copper-silica catalyst was precipitated by mixing equimolar amounts of copper nitrate and sodium silicate. The precipitated copper-silica catalyst was washed, dried, and heat treated at high temperatures. The effect of preparational variables upon catalyst activity was investigated. The optimum conditions were precipitation at 25–55 C, drying the precipitate by freeze drying and heat treatment at 500 C. The catalyst obtained under these conditions is more than three times as active as a commercial copper-chromite catalyst.

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SELECTIVE HYDROGENATION OF SOYBEAN OIL. IX. EFFECT OF HIGH PRESSURE ON COPPER CATALYSIS. T.L. MOUNTS, S. KORITALA, J.P. FRIEDRICH, and H.J. DUTTON, Northern Regional Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604.

Selective hydrogenation of soybean oil with copper catalysts at 50 psi or less is characterized as a relatively slow reaction, requiring higher catalyst concentrations than the less selective but rapid nickel catalyzed reactions used in most commercial practice. Hydrogenations of soybean oil have been performed which included a high pressure scan (500, 1000, 3000 psi) at selected temperatures (110, 130, 150, 170 C) and at specific catalyst concentrations (0.05, 0.1, 0.2, 0.4% copper). Selectivities, reaction rates and geometric and positional isomerism have been determined as an evaluation of the effects of high pressure on the kinetics of the reaction. The experimental results indicate that appropriate selection of pressure, temperature, and catalyst concentration can permit: (a) a significant increase in the overall reaction rate while retaining the high selectivity of copper catalysts, (b) use of lower concentrations of copper catalyst while maintaining the higher reaction rate, (c) elimination of conjugated diene as a measurable product in the hydrogenated oil.

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PRESENT SITUATION ON SYNTHETIC FATTY ACIDS. HERBERT FINEBERG, Ashland Oil Company. Columbus, OH 43216.

Abstract not available at press time.

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DEVELOPMENTS IN SYNTHETIC FATTY ACIDS. N.O.V. SONNTAG, Glyco Chemicals, Inc., PO Box 330, Williamsport, PA 17701.

Despite the fact that petroleum price increases discourage it, synthesis of fatty acids from petro basetocks is still with us. And while we have not seen U.S. production of these materials on any large scale basis, although Japanese and Russian industry is well along with it, we can still not discount the various possibilities. The prospects for U.S. production will be reevaluated and reviewed in the light of several new developments, both economic and synthetic. This paper will review the new developments in synthetic approaches to both straight chain and branched chain synthetic fatty acids derived from petroleum.

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NEO-ACIDS—SYNTHETIC HIGHLY BRANCHED ORGANIC ACIDS. M. FEFER, Exxon Chemical Company U.S.A., PO Box 3272, Houston, TX 77001.

Neo acids are highly branched synthetic trialkyl acetic acids manufactured by reacting an olefin with high purity carbon monoxide under high pressure in the presence of an acidic type catalyst. The starting olefins for neopentanoic (C_5, single isomer) and neodecanoic (C_{10}, mixed isomers) acids are isobutylene and nonene respectively. Commercial quantities of both products have been available since 1964. Neopentanoic acid is used in the preparation of t-butyl peroxy neopentanoate (pivilate), a peroxyester initiator used in polyethylene manufacture. The C_5 neo acid also finds use in a variety of other industrial end uses, e.g., pharmaceutical, agricultural chemicals, and reaction to form hindered, very stable esters. Metal salts of neodecanoic acid are used in paint driers, polyvinyl chloride stabilizers, and peroxyester initiators. Other reactions such as esterification, amide formation, and reaction with ethylene oxide will be discussed.

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PRESENT AND FUTURE MARKET FOR SYNTHETIC FATTY ACIDS. R.M. HULL, Hull and Company, Bronxville, NY.

Abstract not available at press time.

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HEPTANOIC ACID. NELSON E. LAWSON, Union Camp Corporation, Princeton, NJ 08540.

Abstract not available at press time.

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STRAIGHT CHAIN ALIPHATIC FATTY ACID ESTERS AND ISOMERIC ALIPHATIC FATTY ACIDS IN LUBRICANTS. EDMUND J. NIEDZIELSKI, Du Pont Organic Chemicals Dept., Wilmington, DE.

Abstract not available at press time.

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UPDATE ON SYNTHETIC FATTY ACIDS. KARL T. ZILCH, Emery Industries, Cincinnati, OH 45232.

Abstract not available at press time.

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PROCESSING AND USES OF SYNTHETIC FATTY ACIDS. E. FUOCHI, L. FERRARA, and B. BERTI, Liquichimica of America, Inc., 45 Rockefeller Plaza, New York, NY 10020.

A new technique is described for the production of synthetic fatty acids starting from normal paraffins through the formation of oxoderivatives and following sodium fusion. These new products are among those included in the development product strategy of Liquichimica which utilizes normal paraffins as building block for the production of intermediates mainly for the detergent industry and for the synthesis of new surface active agents. The synthetic fatty acids, as already proven with other normal paraffins derivatives, are destined to replace more and more products derived from raw material of natural origins. This is to avoid fluctuations of price and availability of the natural materials. The same raw materials now utilized for the production of fatty acids and other products could be used for obtaining food products, contributing therefore to a better utilization of the natural resources. The new industrial process for the production of synthetic fatty acid is then described and the most interesting area of utilization is listed.

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AN INTEGRATED APPROACH TO THE PROBLEM OF OBESITY. JULES HIRSCH, ROBERT BURR, IRVING FAUST, BRUCE SCHNEIDER, JOEL GRINKER, and PATRICIA JOHNSON, Rockefeller University, 1230 York Ave., New York, NY 10021.

At the present time, obesity is the most prevalent risk factor for a variety of serious degenerative diseases. Yet, even the newest approaches to treatment remain largely

unsatisfactory. Work on adipose tissue cellularity gives further evidence for the existence of longterm regulation of caloric storage in man and animals and it is likely that disturbance of these mechanisms can be a major etiologic factor in human obesity. Treatment failure is in large measure due to a lack of understanding of the nature of these regulatory mechanisms. The evidence for these statements and the significance of these observations will be considered.

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METABOLIC CHARACTERISTICS OF OBESITY. ANN C. SULLIVAN, Department of Biochemical Nutrition, Roche Research Center, Hoffmann-La Roche Inc., 340 Kingsland St., Nutley, NJ 07110.

The genetically obese Zucker rat is a useful model of human obesity, particularly the hyperplastic type. An evaluation of the metabolic characteristics of obese and lean Zucker rats was undertaken in an attempt to: (a) define the metabolic aberrations and relate them to the human disease, whenever possible, and (b) identify possible routes of pharmacological intervention. Various parameters of lipid metabolism, carbohydrate metabolism, hormonal status, and adipose tissue cellularity were assessed in Zucker rats under ad libitum feeding conditions. Circulating serum lipid levels were significantly elevated in the obese rats. In vivo rates of hepatic fatty acid synthesis, as determined by the incorporation of ^3H_2O and [^{14}C]alanine, were enhanced 4-fold and 17-fold, respectively, in the obese. Lipogenic rates in small intestine were also elevated in the obese, whereas adipose tissue rates from three depots were similar in obese and lean rats. The mild hyperglycemia and moderately increased hepatic glycogen levels in the obese rat apparently did not result from altered rates of hepatic or renal gluconeogenesis and/or glycogenesis. In vitro rates of gluconeogenesis in kidney slices and in vivo hepatic rates of glycogen synthesis, determined from ^3H_2O and [^{14}C]alanine precursors, were similar in obese and lean rats. An enhanced release of insulin and a diminished release of glucagon were observed in pancreatic islets from obese compared to lean animals. This altered hormone secretion pattern was also reflected in circulating levels. These metabolic differences in obese and lean rats were evident in young animals at an age when the obese were still proliferating adipose cells and the lean had ceased adipose proliferation. Whether the metabolic aberrations in the obese defined in this and other studies(a) produce, (b) result from, or (c) occur independently of this hyperplastic adiposity and increased body fat remains to be determined.

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ASPECTS OF ADIPOSE TISSUE DEVELOPMENT IN RODENTS. PATRICIA R. JOHNSON, Dept. of Biology, Vassar College, Poughkeepsie, NY, and IRVING M. FAUST and JULES HIRSCH, Rockefeller University, New York, NY.

A major tenet of the "adipose cell hypothesis of obesity," which has been put forth by Jules Hirsch and his colleagues, is that the cellular morphology of adipose tissue has an active rather than a passive role in the regulation of energy balance in mammals. The cell type primarily involved in adipose tissue function is the lipid-laden white adipocyte. These cells account for the changes in adipose tissue weight which occur during growth, development, and varied metabolic states; e.g., fasting. Our recent studies have examined the regulation of adipocyte size and number in laboratory rodents subjected to subtotal lipectomy. One specific objective of these studies is to determine whether or not adipocyte proliferation is regulated in the same sense that hepatocyte proliferation is regulated, to define the nature of the regulation if it exists, and to identify those factors which may alter it. We have found that rats and mice do not compensate for the removal of epididymal fat either by replacing the lost tissue at the site, or by accumulating more lipid in other depots. We have also found that rats do regenerate subcutaneous fat provided that subcutaneous lipectomy is performed early in the rat's life. New fat cells appear within 4 wk after surgery. If lipectomized rats are fed a high fat diet, the regenerative process is complete by 7 mo. In rats fed a low fat chow diet, it is only 50% complete by 7 mo. The complete regeneration of subcutaneous fat in high fat-fed lipectomized rats occurs primarily at the surgical site and the tissue is totally restored in terms of adipocyte number and size. The significance of these findings for an understanding of adipose tissue growth and differentiation will be discussed.

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FAT CELL METABOLISM IN THE SPONTANEOUSLY OBESE RAT AND THE OB/OB MOUSE. MICHAEL P. CZECH and DOUGLAS K. RICHARDSON, Section of Physiological Chemistry, Box G, Brown University, Providence, RI 02912.

It was recently established that the major cellular defect which blunts the insulin responsiveness of large adipocytes obtained from spontaneously obese, old rats is an impaired capacity of one or more intracellular enzymes to metabolize glucose rather than the insulin effector system itself. In the present studies fatty acid synthesis and the pentose shunt were identified as the key inhibited pathways involved. Fatty acid synthetase and acetyl coenzyme A carboxylase activities in homogenates derived from large cells were inhibited by 84% and 90%, respectively, when compared to small cells. While pentose shunt flux in intact fat cells was markedly inhibited in the obese rat, the activities of key pentose shunt enzymes in homogenates of large and small adipocytes were similar on a per cell basis. Furthermore, the reduced nicotinamide adenine dinucleotide phosphate (NADPH) oxidant vitamin K$_5$ completely restored pentose shunt activity in large cells to the elevated levels observed in small fat cells in the presence of this agent or insulin. The data suggest that the fatty acid synthetic pathway is the primary defect in large rat adipocytes which leads to allosteric inhibition of pentose shunt activity by NADPH. Glucose utilization in fat cells from 13 wk old ob/ob mice was also resistant to the action of insulin. However, ob/ob mice between 4 and 7 wk of age actually exhibited a dramatic increase in sensitivity to the ability of insulin to stimulate both glucose transport system activity and glucose utilization. Fatty acid synthesis was dramatically increased in the fat cells from these young ob/ob mice compared to lean controls. It thus appears that in both animal models of obesity there is a positive correlation between fatty acid synthesis rates and sensitivity of the fat cells to insulin action. Furthermore, the amplified insulin effector system in fat cells from young ob/ob mice may play a key role in the etiology of this obese syndrome.

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DIET RELATED CALORIGENESIS. MURRAY L. KAPLAN, Department of Nutrition, Cook College, PO Box 231, Rutgers, The State University, New Brunswick, NJ 08903.

The concept of calorigenesis will be reviewed. Much controversy is associated with this area. An attempt will be made to critically review what is known about energy metabolism in the intact animal in relation to diet. Several investigators have reported that the composition of the diet may influence calorigenesis in man. Obese individuals with a history of childhood onset obesity exhibit a diminished calorigenic response after a high protein meal. This is in marked contrast to the calorigenic response of anorectic patients. These and other data that will be discussed suggest that diminished calorigenesis may contribute to the development of childhood onset obesity. The composition of the diet during early life, while animals still exhibit considerable development, may influence total energy expenditure. Isocaloric substitution of fat for carbohydrate may result in an increase in oxygen consumption after weaning and result in a leaner adult. The mechanisms of these effects are not currently understood. Possible hypotheses of the mechanisms of calorigenesis will be discussed.

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HUMAN OBESITY: AN OVERVIEW. THEODORE B. VAN ITALLIE, St. Luke's Hospital, WH-10, 114th St. & Amsterdam, New York, NY 10025.

Since 1940, when Hetherington and Ranson reported that obesity could be induced in rats by damaging discrete areas of the ventromedial hypothalamus, a congeries of animal models of obesity has been described. Examples of such models include genetic, diet-induced, and stress-induced obesities. This multiplicity of models suggests that, as in the rat, obesity in man may have a variety of causes. Moreover, in individual cases of human obesity, the disorder may be multifactorial. If these assumptions are correct, studies of groups of obese subjects that fail to take into account their heterogeneity are likely to yield uninterpretable results. Apart from the rare cases of obesity attributable to brain damage, drugs, or endocrinopathy, there is preliminary evidence for the existence of at least two common types of obesity; a type that has its onset in childhood and a type that becomes manifest during adult life. At the present time, juvenile- or growth-onset obesity is thought to be characterized by hyperplasia as well as hypertrophy of fat cells, while adult-onset obesity is thought to be characterized by adipocyte hypertrophy without hyperplasia. Unfortunately, the morphologic distinction between the two forms is not clear-cut; there are many exceptions. It has also been suggested that obese individuals are biologically programmed to be fat, thereby accounting for the extremely high recidivism rate that follows attempts at weight reduction. At present, one of the highest priorities of obesity research is the need to evolve a meaningful classification of human obesities that would be grounded in etiology and have value both in selecting appropriate therapy and estimating prognosis. Development of an appropriate classification will require a multidisciplinary effort that should include consideration of genetic, morphologic, metabolic, psychological, and environmental factors.

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FLAVOR COMPONENTS IN FOODS PRODUCED BY THE OXIDATION OF LIPIDS. STEPHEN S. CHANG, Department of Food Science, Cook College, Rutgers, The State University, New Brunswick, NJ 08903.

The volatile flavor constituents produced by oxidation of lipids may have either desirable or undesirable flavor characteristics. The development of the "stale" flavor in potato chips is partly due to the increase in saturated aldehydes, methyl ketones, and 2-enals. However, it is also due to the decrease of the desirable 2,4-dienals at the same time. During deep-fat frying, more than 200 different compounds have been identified as volatile decomposition products. Some of them may have objectionable flavors and some of them may contribute to the desirable flavor of freshly fried foods. Lipids may be either important or not to the volatile flavor constituents of foods. Examples will be given to show that the oxidation products of lipids are not the major contributors to the flavor of certain foods. On the other hand, they may be important. In such cases, the desirable flavor may be produced either by the oxidation of oil alone or by the interaction between the volatile decomposition products of the oil and those of amino acids.

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REACTIONS BETWEEN PEROXIDIZING LIPIDS AND HISTIDYL RESIDUE ANALOGUES: ENHANCEMENT OF HYDROPEROXIDE DECOMPOSITION AND BROWNING BY 4-METHYLIMIDAZOLE. SAMUEL H. YONG and MARCUS KAREL, Rm. 56–117, MIT, Cambridge, MA 02139.

As a part of our study on the interactions between peroxidizing lipids and the histidyl imidazole ring in simple, low-moisture model systems, 4-methylimidazole (4MI) was reacted with methyl linoleate to avoid interference from other functional groups in histidine (free base) or proteins. Changes in peroxide values, carbonyl values, extent of browning, and 4MI concentrations were followed over a period of 3 wk. The results indicate that 4MI exhibits significant prooxidative activities by reducing the induction period as well as by enhancing hydroperoxide decomposition and formation of brown pigments. The mechanisms of 4MI-mediated hydroperoxide decomposition and browning are discussed in terms of progressively decreasing 4MI concentrations and the structures of the 4MI reaction products formed during incubation.

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THERMAL INTERACTION OF LINOLEIC ACID WITH AMINO ACIDS. SUSAN HENDERSON and W.W. NAWAR, Department of Food Science and Nutrition, University of Massachusetts, Amherst, MA 01003.

High temperature protein lipid interactions are currently being investigated in our laboratory using model systems of glycerides, free fatty acids, and amino acids. Samples are heated under controlled conditions in the presence of oxygen. In this study, the following systems were treated under identical conditions: (a) linoleic acid alone, (b) the amino acid (valine or lysine) alone, and (c) linoleic acid and amino acid mixture. The decomposition products of each of these samples were analyzed by vacuum distillation, chemical separa-

tion methods and combined gas chromatography-mass spectrometry. Identified new decomposition products, not formed originally when each compound was heated alone, included alkyl pyrroles, alkyl pyridines, alkyl cyanides, and substituted amides. In addition, certain compounds which are normally produced when linoleic acid or the amino acid are heated separately were absent in the interaction sample.

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EVALUATION OF FACTORS AFFECTING THE BINDING OF POLAR AND NEUTRAL LIPIDS TO FISH ACTIN AND MYOSIN. SOLIMAN Y.K. SHENOUDA, National Marine Fisheries Service, USDC, NOAA, Gloucester, MA, and GEORGE M. PIGOTT, Institute for Food Science and Technology, University of Washington, Seattle, WA.

The difficulties of defatting fish protein concentrates (FPC) and the deterioration in texture of frozen-stored fishery products are among the problems attributed to lipid-protein complex formation. Such complexes probably are formed and manifested during the fish processing steps. The influence of several factors usually employed in food manufacture such as temperature, pH, ionic strength, presence of divalent cations, foam formation as consequence of pumping or agitation, aging, etc., on lipid-protein interaction were studied using model systems consisting of fish-actin or fish-myosin and fish-polar or fish-neutral lipids. C-14 fish lipids used in the study were successfully obtained by injecting acetate, glycerol, and triglyceride isotopes into anesthetized fish; and the fish lipids, labeled with C-14, were extracted later. Myosin and actin showed different binding characteristics. Myosin did not show any tendency to bind with fish lipids, while actin bound quantitatively more polar lipids and its degree of binding with neutral lipid was stronger. Lipid-protein interaction was more dependent on the protein moiety, and any denaturation of the actin or myosin caused lipoprotein complexes which were difficult to reseparate by simple physical means. Heating, foam-formation and polymerization of actin caused exposure of more hydrophobic regions on the protein molecules as indicated by increased neutral lipid binding. Lowering the pH of the heated myosin near its isoelectric precipitation decreased the bound neutral lipid which was interpreted as being due to an increase in the total charge on the myosin molecules near their isoelectric precipitation. Spin labeling studies showed that sulphydryl and amino sites of the actin were not affected during lipid-actin interaction. In conclusion, the study revealed the impact of some processing steps on lipid-protein complex formation.

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INTERACTION OF LIPIDS WITH PROTEINS AND CARBOHYDRATES IN BREADMAKING. Y. POMERANZ and O.K. CHUNG, U.S. Grain Marketing Research Center, 1515 College Ave., Manhattan, KS 66502.

Lipids, which comprise about 1.5% of wheat flour, have numerous functions in dough mixing, fermentation, and baking. The main functions are dough lubrication, modification of gluten structure, regulation of protein aggregation and insolubilization, catalysis of —SH oxidation and protein polymerization, regulation of interaction among starch granules and rate of starch gelatinization, regulation of water transport among dough and bread components, and contribution to bread quality as assessed by loaf volume, crumb grain, and freshness retention. The contributions of flour lipids to those functions involve mainly interactions between nonpolar and polar lipids (primarily glycolipids) and proteins in dough and among polar lipids, proteins, and starch in bread. Those interactions, were recently shown to have either deleterious or improving effects in flours varying in breadmaking quality. Studies of interactions among lipids and other wheat flour components have important implications in the use of surface active agents (such as sucroesters or stearoyl lactylates) in the production of regular bread and especially protein-enriched bread of satisfactory consumer acceptance.

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THE SIGNIFICANCE OF NATURAL POLYPHENOLS WITH RESPECT TO TASTE AND COLOR IN OILSEEDS AND CEREAL PROTEIN FOODS. A.B. DURKEE, Food Research Institute, Canada.

The chemical structures of natural polyphenols determine the extent of their interference during the preparation of protein concentrates and isolates from oilseeds, cereal grains and other seeds, for use as extenders to or replacements for animal protein foods. Taste, color and other quality factors are largely due to the oxidation, subsequent polymerization, and binding capacity of natural phenols or their degradation products with protein. How these processes and specific structural characteristics of phenols are related and could cause taste problems and discoloration to the product are discussed in some detail with respect to known phenolic substances of the seeds. Our own experimental work and that of others on identification of polyphenols in dehulled seed meals and isolates suggests that monomeric substances may play a more important role in discoloration than natural oligomeric tannins, since the latter are not present in forms that are easily separated or identified as true tannins. In any event certain degradative reactions and oxidative conditions are difficult to avoid, using the present methods for separation of a suitable protein fraction from seed meals.

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SEPARATION OF SATURATED FROM UNSATURATED COMPOUNDS USING A CELITE-PALLADIUM CHLORIDE COLUMN. DANIEL P. SCHWARTZ, Eastern Regional Research Center, ARS, USDA, 600 East Mermaid Lane, Philadelphia, PA 19118.

In a simple, rapid, micro procedure, unsaturated compounds are retained by a Celite-palladium chloride column while saturated compounds pass through and are recovered in the effluent. Approximately 3 μg of an unsaturated methyl ester is retained per mg of column packing when hexane is used as solvent. Unsaturated alcohols, acids, aldehydes, ketones, cholesteryl esters, and glycerides are also held but not the saturated members of these classes. Olefinic hydrocarbons are not retained, suggesting that slight adsorption might be a prerequisite to complexation of the double bond. The quantitative aspects of the procedure will be discussed and its application to model and complex natural mixtures will be presented.

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RAPID DETERMINATION OF ACYL GROUPS IN MICROGRAM AMOUNTS OF PHOSPHOLIPIDS. WILLIAM N. MARMER, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

Rapid and convenient methods for the determination of acyl groups in microgram amounts of phospholipids have been developed. The reactions, transmethylation and hydrolysis, are carried out on reagent-impregnated Celite within capillary columns that are readily prepared from Pasteur pipettes. Columns may be prepared in advance and sealed for long-term storage. The methods were tested on solutions containing mixtures of (14:0)$_2$ phosphatidylcholine and (16:0) lysophosphatidylcholine. Transmethylations of the lipids in CH_2Cl_2 solution were performed on KOMe-Celite columns at room temperature. Short reaction times were mandatory, since slow concomitant hydrolysis caused diminished ester yields after 6 min. Alternatively, acid-catalyzed transmethylations were carried out with methanol on Amberlyst 15-Celite columns. Reactions at 180 C in sealed capillaries for 10 min were sufficient. Again, long reaction times favored hydrolysis. Regioselective hydrolyses were accomplished in minutes on phospholipase A_2-Celite. The esters from transesterifications or fatty acids from hydrolyses were eluted and analyzed by gas liquid chromatography (GLC). The 16:0/14:0 ratios indicated the relative extent of reaction of the choline compounds. All of these procedures require 1/1000 the amount of lipid called for in standard procedures and take advantage of the increased sensitivity of modern GLC instrumentation. These new procedures are ideally suited for use in conjunction with thin layer chromatography separations.

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GLYCERIDE STRUCTURE VARIATION IN SOYBEAN VARIETIES. S.H. FATEMI and E.G. HAMMOND, Department of Food Technology, Iowa State University, Ames, IA 50011.

Stereospecific and silver ion analyses were done for 20 samples of soybeans and closely related species. The samples represented both seasonal variation and a wide range of fatty acid compositions. There was little difference in the glyceride structure of a soybean variety grown in different years. Stereospecific analyses revealed a linear relation between the percentage of a fatty acid in a particular position and the percentage in the whole fat. Varieties with genetically deviant structures would not fall on this line. One such variety was found that tended to have more linoleic acid on the 1 and 2 positions and less on the 3. The converse was true for the distribution of oleic acid on the three positions. The results of the stereospecific analyses were used to calculate the amounts of the triglycerides expected by the 1-random-2-random-3-random hypothesis, and these values were compared with the silver ion results. This revealed that triolein and trilinolein were present in much greater amounts than predicted by random theory while triglycerides containing a combination of oleic and linoleic acids tended to be underrepresented in the oil. We suggest that this is because the peak production of oleic and linoleic acids do not coincide during maturation and oil deposition in soybeans.

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DETERMINATION OF ALPHA TOCOPHEROL IN PLATELETS BY GAS LIQUID CHROMATOGRAPHY. JOANNA LEHMANN, Nutrition Institute, ARS, USDA, Beltsville, MD 20705.

A method will be described for the separation and determination of alpha tocopherol in platelets by gas liquid chromatography (GLC). The method is specific for alpha tocopherol and does not require a thin layer chromatographic step for separation from impurities. Ethanol (2 ml) containing a known amount of 5,7-dimethyltocol (0.5 μg/ml) as internal standard and 10% pyrogallol was added to washed platelets. The mixture was saponified under nitrogen for 5 min and tocopherols were extracted into petroleum ether. Tocopherols were chromatographed as the trimethylsilyl ethers on 0.3% Apiezon L at 245 C. Average recovery of alpha tocopherol added to vitamin E deficient platelets was 93%. Alpha tocopherol content of platelets (μg/10^9 platelets) of several species as determined by this method was rats 3.6 (n = 4); rabbits, 0.56 (n = 2); humans, 0.69 (n = 2); and swine 0.14 (n = 2). The method has also been applied successfully to the analysis of alpha tocopherol in plasma, adipose tissue, and testes.

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CHEMICAL IONIZATION MASS SPECTROSCOPY TECHNIQUES FOR CHARACTERIZATIONS OF LIPIDS. A.K. BOSE, B.N. PRAMANIK, B. PATEL, B.G. PUJAR, and H. FUJIWARA, Stevens Institute of Technology, Castle Point Station, Hoboken, NJ 07030.

Chemical ionization-mass spectroscopy (CI-MS) is a powerful tool for the study of various lipid components. When ammonia is used as the reagent gas, the senstivity of this mass spectral method is increased and strong quasimolecular ions are observed for many types of compounds. Deproteinized blood samples provide a detailed picture of individual components such as, triglycerides, lysolecithins, cholesterol esters, etc. For simplifying the study of the sterols fraction we have found it convenient to treat the total sterols with AlBr$_3$ in dry ether. The 5-sten-3β-ols are selectively converted to Δ^5-3-bromides but other sterols are unaffected. This reaction mixture can be separated easily on silica gel thin layer chromatography (TLC) plates into various fractions. Saturated sterols (for example, cholestanol) and non-homoallylic unsaturated sterols (viz, Δ^7-cholesten-3β-ol) appearing at different R_f values can be now studied by EI and CI-MS methods. In case of unsaturated fatty acids RnO_4 oxidation followed by CI-MS (NH_3) analysis of the total reaction product permits ready location of double bonds. The application of these techniques to lipid mixtures from marine sources will be discussed.

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PRACTICAL APPLICATION OF THE METTLER DROPPING POINT AND STATISTICAL ANALYSIS OF ITS USE AS A WILEY MELTING POINT PREDICTOR. ILONA E. KOCAN, Dwight P. Joyce Research, Durkee Foods Division, SCM Corp., 16651 Sprague Rd., Strongsville, OH 44136.

The Mettler FP5/53 automatic dropping point instrument was investigated to determine its precision and reliability when used as a melting-point indicator for edible fats and oils. This precision is compared to the precision of the official AOCS-Wiley Melting Point method for various hydrogenated oils. Regression analysis was performed to determine the relationship between Mettler Dropping Point and Wiley Melting Point. For monitoring hydrogenation, the total analysis time is 15

to 20 min, using a modified method. The Mettler Dropping Point can be used either as an independent melting point indicator or as a predictor for Wiley Melting Point.

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DEVELOPMENT OF THE FISH OIL INDUSTRY IN THE UNITED STATES. MAURICE E. STANSBY, Northwest Fisheries Center, NMFS, NOAA, USDC. 2725 Montlake Blvd., East Seattle, WA 98112.

The historical development of the fish oil industry in the United States from its early beginnings in the nineteenth century to the present time will be treated briefly. Changes in types of fish oils produced and usage for the oil over the years will be included. The current status of the U.S. industry with main emphasis on the types of uses will be covered. Special attention will be paid to the potential usage for edible products containing fish oils for marketing in the United States. Problems restricting such usage will be discussed.

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THE STORY OF MENHADEN. A.P. BIMBO, Zapata Haynie Corporation, PO Box 175, Reedville, VA 22539.

A 25 min film describes the catching and processing of the menhaden, a species of fish which accounts for 66% of the total poundage of fish and shellfish landed in the U.S.

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A REVIEW OF THE PRODUCTION OF INDUSTRIAL MARINE OILS. A.P. BIMBO, Zapata Haynie Corporation, PO Box 175, Reedville, VA 22539.

World marine oil production was projected at 1.075 million metric tons in 1976 or 2.2% of the total world production of fats and oils. In most countries, marine oils are considered edible; however, in the United States, they are still classified as inedible or industrial grade oils. A review is presented of the methods of processing industrial marine oils and specifically menhaden oil which comprises 86.5% of the total U.S. marine oil production.

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WALVIS BAY—FISH FOR THE WORLD. A.A. SPARK, Fishing Industry Research Institute, Private Bag, Rondebosch 7700, South Africa.

The fisheries at Walvis Bay (South West Africa), in terms of canning and fish meal and oil production, are very much larger than many people think. From a catch of just short of one million tons, some eleven million cases of canned fish, 200,000 tons of meal, and 35,000 tons of oil, were produced in 1975. The outline of the conditions at Walvis Bay and the part Fishing Industry Research Institute plays in this industry are outlined and some of the investigations introduced. These include bulk handling and antioxidant treatment of fish meals.

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A SIMPLIFIED PRESENTATION OF FATTY ACID COMPOSITIONS IN FISH OILS AND OTHER MARINE LIPIDS. GEORG LAMBERTSEN, Government Vitamin Institute, Directorate of Fisheries, PO Box 187, N-5000, Bergen, Norway.

Modern methods of chromatography readily show the wealth of fatty acids present in marine lipids. A full table of compositions is necessary for the understanding of these lipids, but the table is often bewildering in daily work with fish oils. Eight fatty acids make up around 90% of the fatty acids in most marine lipids. These fall naturally into four pairs, and in concise form characterize marine fats. They are well adapted for making comparisons and predicting storage characteristics. A future standardization of fish oils, as in Codex Alimentarius, may need such a simplified presentation of fatty acid compositions.

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THE LANTERN FISH—AN UNEXPLOITED RESOURCE. A.A. SPARK, Fishing Industry Research Institute, Private Bag, Rondebosch 7700, South Africa.

The lantern fish is widespread and has been estimated to constitute a resource in excess of 100 million tons, equal to the total resource of all other exploited marine species. It has been caught in commercial quantities off the South African coast and used for fish meal and oil. The fish is very high in oil and analysis of the oil is reported.

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REMOVAL OF PESTICIDE RESIDUES FROM MENHADEN OIL. LEVENTE L. DIOSADY, Cambrian Processes Ltd., 2465 Cawthra Rd., Unit 112, Mississauga, Ontario, L5A 3P2, Canada.

A modular glass deodorizer consisting of eight contact stages was built. The unit operates continuously with a capacity of ca. 2 liters/hour. The contact mechanism approximates the performance of the Cambrian Compact Deodorizer. Samples of menhaden oil were treated in an attempt to reduce their pesticide residue content. A series of runs were made at different temperatures, pressures, and sparge rates. The free fatty acid content, DDT, eldrin, dieldrin, and polychlorinated biphenol (PCB) concentration in the oil and in the shell drain were analysed. The degree of polymerization of the oil was monitored. Optimum conditions were determined for removing the pesticide residues to legally acceptable levels while minimizing fatty acid losses. The oil quality was not affected by the treatment.

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STEPWISE REMOVAL OF CHLORINATED HYDROCARBONS DURING PROCESSING OF HERRING OIL FOR EDIBLE USE. R.F. ADDISON, Bedford Institute of Oceanography, and R.G. ACKMAN, Environment Canada, Halifax Laboratory, Dartmouth, Nova Scotia, Canada.

Residues of chlorinated hydrocarbon insecticides and of polychlorinated biphenols (PCB) have been examined in "naturally" contaminated marine oils subjected to pilot plant processing and refining. *p,p'*-DDE, *p,p'*-DDD, *p,p'*-DDT, PCBs and dieldrin stayed fairly constant (respectively ca. 1, 0.4, 0.5, 9 and 0.15 ppm) throughout a phosphoric acid wash, alkali refining, and bleaching. Upon hydrogenation, *p,p'*-DDD, *p,p'*-DDT and dieldrin dropped to below detectable levels (i.e. >90% reduction in all cases) while *p,p'*-DDE and PCBs dropped to about 20% and 30% of initial values. Deodorization removed final traces of the latter residues. The data are consistent with the more "polar" residues (*p,p'*-DDD, *p,p'*-DDT and dieldrin) being removed efficiently during hydrogenation, probably through adsorption on to the catalyst, while less polar residues (*p,p'*-DDE and PCBs) are only inefficiently removed at this stage. It is clear that complete processing, including deodorization, effectively removes all detectable traces of these common chlorinated hydrocarbon residues.

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FATTY ACID PROCESSING. ROBERT WIGGINS, Humko Sheffield Chemical, Memphis, TN.

Abstract not available at press time.

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FATTY ACID SITUATION IN EUROPE. THEO. E.A. ARTS, Akzo Chemie GmbH.

Abstract not available at press time.

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PRESENT AND FUTURE MARKETS FOR NATURAL FATTY ACIDS. R.M. HULL, Hull and Company, Bronxville, NY.

Abstract not available at press time.

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EXPANDING MARKETS FOR NATURAL FATTY ACIDS. Emery Industries, Cincinnati, OH.

Abstract not available at press time.

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ISOSTEARIC ACID. ROGER DANIELS, Union Camp Corp., Savannah, GA 31410.

Abstract not available at press time.

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FATTY ACIDS FOR DERIVATIVE USE. Armak, Chicago, IL.

Abstract not available at press time.

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HYDROGENATION CATALYSTS FOR FATTY ACIDS. V. DOHRER, Konigswarter and Ebell, Chemische Fabrik GmbH,

Abstract not available at press time.

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ATOMIC ABSORPTION SPECTROSCOPY SUBCOMMITTEE: PAST AND PRESENT ACTIVITIES. K.M. BROBST, A.E. Staley Mfg. Co., 2200 E. Eldorado St., Decatur, IL 62525.

This subcommittee was added to the Instrumental Techniques Committee in April, 1968. Since then the subcommittee has completed several collaborative studies during the investigation and evaluation of methods for the determination of trace metals in vegetable oils by atomic absorption spectroscopy. The first studies were made with a direct method by sample dilution with methyl isobutyl ketone. Results were judged acceptable and the procedure was added to the AOCS Methods Manual as Tentative Method Ca 15–75. Since then the graphite furnace technique has been investigated and two collaborative studies have been completed. Further studies of this technique are planned along with the writing of a method in AOCS format.

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INFLUENCE OF FLUORESCENT LIGHT AND COPPER ON ANTIOXIDANT AND PRO-OXIDANT EFFICIENCY OF CERTAIN FOOD ADDITIVES. M.H. CHAHINE, Nova Scotia Research Foundation Corporation, PO Box 790, Dartmouth, Nova Scotia, Canada, B2Y 3Z7.

Purified and distilled herring methyl esters were treated with 0.01% tertiary butylhydroquinone (TBHQ), propyl gallate (PG), butylated hydroxyanisole (BHA), and butylated hydroxytoluene (BHT), citric acid (CA) and ascorbyl palmitate (AP). The additives were added to the esters both individually and in various combinations. The treated esters were stored at 35 C and exposed to fluorescent light at an intensity of 94 footcandles. For comparison a second set of herring esters enriched with the same additives was kept in the dark at 35 C. The autoxidation reaction was followed by the weight gain method. Fluorescent light simultaneously accelerated the autoxidation of both herring esters and the incorporated antioxidants. As a result the protective factor of the tested antioxidants decreased by 50%. The relative inhibition effect of individual antioxidants decreased in the following order: TBHQ > BHA > BHT > PG, with respect to retardment of autoxidation of herring esters. This took place in stabilized herring esters both when exposed to fluorescent light and in the dark. The addition of TBHQ to herring esters stabilized with PG, BHT, and BHA resulted in antagonism with respect to the combined antioxidant effect of the examined stabilizers; this occurred in presence and absence of fluorescent light. In most cases CA had no or limited stabilizing effect on herring esters when added alone or together with antioxidants. AP exhibited pro-oxidant effect on herring esters when incorporated alone or together with antioxidants. The copper-AP complex which results from chelation of the copper originally present in the esters (<0.04 ppm) by AP, is known to have pro-oxidant effect. The influence of fluorescent light on the pro-oxidant effect of added AP to the esters was evaluated.

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FEASIBILITY OF TREATMENT OF STORED CRUDE OILS WITH TERTIARY BUTYLHYDROQUINONE AND OTHER ANTIOXIDANTS. PART II. INFLUENCE OF TRACE METALS AND FREE FATTY ACIDS. M.H. CHAHINE. Nova Scotia Research Foundation Corporation, 100 Fenwick Street, PO Box 790, Dartmouth, Nova Scotia, Canada B2Y 3Z7.

Crude herring oil was stored for 14 mo at 22 C alone and in the presence of the following additives: 0.02% tertiary butylhydroquinone (TBHQ), 0.02% propyl gallate (PG), 0.02% butylated hydroxyanisole (BHA), 0.02% citric acid (CA), 0.001% cupric chloride (Cu^{+2}), 0.002% Cu^{+2}, 0.001% ferric chloride (Fe^{+3}), and 0.002% Fe^{+3}, both individually and in various combinations. The autoxidation reaction was followed at regular intervals by measuring the increase in the level of secondary oxidation products, determined by the anisidine value (AV). At termination of the storage period, the AV of the untreated oil was equal to 49.9. In addition

the AV amounted to 32.7, 39.5, 41.9, and 46.2 in oils treated with TBHQ, CA, PG, and BHA, respectively. Furthermore, the AV amounted to 56.6, 62.0, 83.9, and 104.9 in oils treated with 0.001% Fe^{+3}, 0.002% Fe^{+3}, 0.001% Cu^{+2}, and 0.002% Cu^{+2}, respectively. The examined trace metal salts decreased substantially the stabilization potency of TBHQ. The AV of the oils treated with 0.02% TBHQ + 0.001% Fe^{+3}; 0.02% TBHQ + 0.001% Cu^{+2} amounted to 59.3 and 82.1 respectively, and increased to 66.5 and 85.9 as the concentration of added trace metal salts was doubled. The effect of the additives on the oxidative stability time of the crude oils, at start and termination of the storage period, was determined at 35 C. Inverse relationship was noted between AV levels and oxidative stability times at end of the storage period of the treated crudes. Crude herring oil was supplemented with 5% oleic acid and with 0.02% TBHQ + 5% oleic acid. The treated oils were stored for 14 mo at 22 C. Oleic acid decreased the stabilization potency of TBHQ. As a result the AV of the stored oils increased from 32.7 to 42.8. In addition the oxidative stability time decreased by 4.5 days at termination of the storage period of the treated crudes. Autoxidation of stored crude oils is harmful to both the flavor and oxidative stability after their processing for edible purposes. A parallel relationship has been identified between levels of hydroperoxides in crudes and the resultant occurrence of end products of oxidation; i.e., secondary oxidation products, in deodorized oils. It is preferable to treat stored crude oils with a metal inactivating agent, e.g., citric acid, rather than an antioxidant.

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PHOSPHORUS CONTENT OF SOYBEAN OILS. C.D. EVANS, G.R. LIST, L.T. BLACK and T.L. MOUNTS, Northern Regional Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604.

Degumming, the first step in refining, is largely practiced as an art; consequently, the effects of various conditions on gum removal are unknown. In five commercial soybean oil processing plants, the phosphatide removal by water degumming was found to vary from 75 to 98%. The high percent of phosphorus removal obtained by refiners was consistent in repetitive samples. The degree of phosphatide removal in plant operation may be dictated by many factors in addition to those directed to the most complete removal of phosphorus. Successful extension of steam refining into processing high phosphatide oils will demand exacting conditions. A greater understanding is required than is available today on complete removal of phosphorus and other minor constituents. Analysis for the phosphatide content of various crude and degummed soybean oils by elemental phosphorus analysis, by solvent extraction, and by chromatographic refining will be discussed. Since complete iron removal is essential to obtaining a bland quality soybean oil, the trace iron content of these oils will also be presented.

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METABOLISM AND LIPOGENIC EFFECTS OF THE CYCLIC MONOMERS OF METHYL LINOLENATE IN THE RAT. E.G. PERKINS, The Burnsides Laboratory, University of Illinois, Urbana, IL 61801, and W.T. IWAOKA, University of Washington, Seattle, WA.

Cyclic fatty acids are absorbed by the rat, partially oxidized to CO_2, and a portion of the compound, presumably the ring structure, is excreted in the urine. Studies with uniformly-labeled cyclic fatty acids showed that approximately 13–15% of $^{14}CO_2$ is expired by the animal in 48 hr with peak expiration occurring between 4–6 hr after ingestion. Approximately 40% of the total radioactivity is found in the urine after 48 hr with about 60% being excreted within 12 hr after ingestion. Decreased rates of lipogenesis were observed in livers of animals fed 8% and 10% protein and higher levels of cyclic fatty acids. An increased rate of lipogenesis was observed in adipose tissue of animals fed 10% protein and higher levels (0.025, 0.15%) of cyclic fatty acids.

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BIOLOGICAL EFFECTS DUE TO CHANGES IN FATS DURING HEATING. J.C. ALEXANDER, Department of Nutrition, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

In deep-fat frying, often the fat is kept hot for long periods at ca. 180 C. It is used over and over again, and moisture and air are mixed into the hot oil. Substantial quantities of the heated fat are absorbed into the fried foods. Many reports from experimental observations with animals fed these fats have shown biological effects ranging from a slight depression in growth, all the way to very poor growth, diminished feed efficiency, increased liver size, fatty necrosis of the liver, and various other organ lesions. Obviously, certain fat constituents may be changed by frying conditions, and the adverse biological effects are relative. We are at the stage in studying these heated fats where selected techniques including biochemical parameters, histopathological evaluations, and tissue culture in monolayers can be good indicators of some of the specific effects on biological tissues. Isolated fractions from heated fat samples, which contained concentrations of cyclic monomer and dimer derivatives, were used in animal studies. Incorporation of the above materials into rat diets produced distended flatulent stomachs and intestines, gastric ulcers, and multiple focal hemorrhages. Histological evaluation of heart, liver, and kidney tissue sections indicated extensive cellular damage. Livers and kidneys exhibited the most severe lesions. Neonatal heart cells established as monolayers on glass coverslips were exposed to fractions from heated or fresh fats. Cellular damage including pyknosis, vacuolization of the cytoplasm, tripolar spindle formation and other mitotic aberrations were observed. Uptake of ^{14}C-labelled fatty acid by the phospholipid and triglyceride fractions of the cells was increased with heated fats.

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AVOIDANCE OF UNDESIRABLE PRODUCTS IN HEATED OILS. R. OHLSON, Karlshamn, Sweden.

Abstract not available at press time.

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CHEMICAL REACTIONS INVOLVED IN THE DEEP-FAT FRYING OF FOODS. STEPHEN S. CHANG, Department of Food Science, Cook College, Rutgers, The State University, PO Box 231, New Brunswick, NJ 08903.

Deep-fat frying is one of the commonly used methods for food preparation. During deep-fat frying, the oil is continuously or repeatedly exposed to air at an elevated temperature. Under such conditions, oxidation, decomposition, and polymerization are unavoidable. The present paper will report the 221 volatile decomposition products and the cyclic and noncyclic polymers formed under such conditions. The impact of these compounds on the flavor of deep-fat fried foods and on human metabolism will also be discussed.

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QUALITY AND HEALTH ASPECTS OF USED FRYING FATS. G. BILLEK and G. GUHR, Unilever Forschungsgesellschaft mbH, Behringstrasse 154, D-2000 Hamburg 50, Germany, and W. STERNER, International Bio-Research, Inc., Hannover, Germany.

Gel permeation chromatography (GPC) allows the determination of dimeric and oligomeric triglycerides in a heated fat irrespective of the presence of oxidized material. An indication of the total amount of polar and oxidized compounds can be obtained by liquid chromatography (LC) on a silica gel column. Over a large number of investigations a good correlation was seen between the results obtained with GPC and LC and the levels of petroleum ether insoluble oxidized fatty acids. The latter is one of the recommended criteria for assessing the quality of used frying fats in Germany; however, the method of determination is time consuming. Several tons of a sunflower oil which had been used in the industrial production of fish finger were separated on a silica gel column into a polar fraction (I), containing practically all oxidised material, and an unpolar fraction (II). The sunflower oil had not been overheated and was taken at that moment when the production would have been stopped, according to factory practice, and the oil discarded. The fractions (I) and (II) as well as the original unheated sunflower oil (III) and the heated sunflower oil (IV) were fed to rats over 18 mo at a level of 20% in the diet. (I) caused a highly significant reduction in weight gain of the animals as compared with (III) but had only an insignificant detrimental effect upon the many biochemical, histological and clinical parameters. The order of the weight gain caused by the 4 samples was: (I) < (IV) < (II) < (III). The changes of other parameters as well as the implications of these long-term feeding studies will be discussed in detail.

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INTRODUCTION: GLYCOLIPID NOMENCLATURE—1977 STYLE. R. BURTON, Washington University Medical School, St. Louis, MO.

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CRITERIA OF PURITY OF GANGLIOSIDES AND OTHER GLYCOLIPIDS. LLOYD A. WITTING, NICHOLAS PELICK, and GARY C. WALKER, Supelco, Inc., Supelco Park, Bellefonte, PA 16823.

With the growing interest in complex glycolipids it has become a serious challenge to prepare the high purity standards used in this field. Many of the research techniques described in the literature are not applicable to preparations based on kg quantities of starting material. Assays based on the ratios of specific moieties produced via hydrolysis (the ratio of hexosamine to total hexose or the ratio of glucose to galactose) are useful for identification purposes. Degradative loses during hydrolysis, however, make it difficult to use many of these assays for the determination of purity. In the case of acid glycolipids, gangliosides, the usual criteria of purity are homogeneity on thin layer chromatography and neuraminic acid content.

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GANGLIOSIDES OF THE NERVOUS SYSTEM. ROBERT W. LEDEEN, Department of Neurology, Albert Einstein College of Medicine, 1300 Morris Park Ave., Bronx, NY 10461.

The four major gangliosides of mammalian brain include the monosialo species G_{M1} and polysialo forms with one or more additional N-acetylneuraminic acids (NAN) added to this basic unit. The asialobackbone for these is gangliotetraose: Gal(β1–3)GalNAc(β1–4)Gal(β1–4)Glc-Cer. A dozen or more minor gangliosides have been characterized in brain, the simplest of which is sialosylgalactosyl ceramide ($G_7 = G_{M4}$) with a unique carbohydrate and lipophilic composition. The most complex to date is a pentasialoganglioside with four neuraminidase sensitive sialic acids attached to G_{M1}; this was isolated from fish brain but has not yet been detected in mammals. Minor brain gangliosides have been characterized with fucose and N-acetylglucosamine, while the latter unit is present in a ganglioside that is sometimes found in peripheral nerve. This contains the lacto-neotetraose (paragloboside) structure as backbone: Gal(β1–4)GlcNAc(β1–3)Gal(β1–4)Glc-Cer with NAN attached (2–3) to terminal galactose. Peripheral nerve contains only a fraction of the total ganglioside content of CNS. Within brain, low to moderate levels of ganglioside have been found in isolated neuronal perikarya, astrocytes, oligodendroglia axons and myelin, while higher concentrations are observed in synaptic plasma membranes and microsomes. Analyses of synaptic vesicles have given variable results and it is not clear whether these structures are free of gangliosides.

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IMMUNOLOGY OF GLYCOSPHINGOLIPIDS. K. SUZUKI.

Abstract not available at press time.

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IMMUNOLOGY OF GLYCOSPHINGOLIPIDS. DONALD M. MARCUS, Albert Einstein College of Medicine, 1300 Morris Park Ave., Bronx, NY 10461.

This presentation will be a review of selected aspects of glycolipid immunology and some applications of antibodies to glycolipids. Pure glycolipids are very weak immunogens but antibodies to them may be elicited by mixing the glycolipid with an immunogenic carrier substance such as methylated albumin or by immunization with intact cells. Most antisera to glycolipids contain a relatively low titer of antibodies and for many studies it is useful to purify the antibodies by affinity chromatography on a column of insoluble antigen. Examples will be provided of the use of anti-glycolipid antibodies to identify functional subclasses of lymphocytes, to evaluate the expression of glycolipid antigens in the membranes of normal and malignant cells, and to determine the localization of glycolipids in tissue sections.

to 20 min, using a modified method. The Mettler Dropping Point can be used either as an independent melting point indicator or as a predictor for Wiley Melting Point.

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DEVELOPMENT OF THE FISH OIL INDUSTRY IN THE UNITED STATES. MAURICE E. STANSBY, Northwest Fisheries Center, NMFS, NOAA, USDC. 2725 Montlake Blvd., East Seattle, WA 98112.

The historical development of the fish oil industry in the United States from its early beginnings in the nineteenth century to the present time will be treated briefly. Changes in types of fish oils produced and usage for the oil over the years will be included. The current status of the U.S. industry with main emphasis on the types of uses will be covered. Special attention will be paid to the potential usage for edible products containing fish oils for marketing in the United States. Problems restricting such usage will be discussed.

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THE STORY OF MENHADEN. A.P. BIMBO, Zapata Haynie Corporation, PO Box 175, Reedville, VA 22539.

A 25 min film describes the catching and processing of the menhaden, a species of fish which accounts for 66% of the total poundage of fish and shellfish landed in the U.S.

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A REVIEW OF THE PRODUCTION OF INDUSTRIAL MARINE OILS. A.P. BIMBO, Zapata Haynie Corporation, PO Box 175, Reedville, VA 22539.

World marine oil production was projected at 1.075 million metric tons in 1976 or 2.2% of the total world production of fats and oils. In most countries, marine oils are considered edible; however, in the United States, they are still classified as inedible or industrial grade oils. A review is presented of the methods of processing industrial marine oils and specifically menhaden oil which comprises 86.5% of the total U.S. marine oil production.

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WALVIS BAY—FISH FOR THE WORLD. A.A. SPARK, Fishing Industry Research Institute, Private Bag, Rondebosch 7700, South Africa.

The fisheries at Walvis Bay (South West Africa), in terms of canning and fish meal and oil production, are very much larger than many people think. From a catch of just short of one million tons, some eleven million cases of canned fish, 200,000 tons of meal, and 35,000 tons of oil, were produced in 1975. The outline of the conditions at Walvis Bay and the part Fishing Industry Research Institute plays in this industry are outlined and some of the investigations introduced. These include bulk handling and antioxidant treatment of fish meals.

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A SIMPLIFIED PRESENTATION OF FATTY ACID COMPOSITIONS IN FISH OILS AND OTHER MARINE LIPIDS. GEORG LAMBERTSEN, Government Vitamin Institute, Directorate of Fisheries, PO Box 187, N-5000, Bergen, Norway.

Modern methods of chromatography readily show the wealth of fatty acids present in marine lipids. A full table of compositions is necessary for the understanding of these lipids, but the table is often bewildering in daily work with fish oils. Eight fatty acids make up around 90% of the fatty acids in most marine lipids. These fall naturally into four pairs, and in concise form characterize marine fats. They are well adapted for making comparisons and predicting storage characteristics. A future standardization of fish oils, as in Codex Alimentarius, may need such a simplified presentation of fatty acid compositions.

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THE LANTERN FISH—AN UNEXPLOITED RESOURCE. A.A. SPARK, Fishing Industry Research Institute, Private Bag, Rondebosch 7700, South Africa.

The lantern fish is widespread and has been estimated to constitute a resource in excess of 100 million tons, equal to the total resource of all other exploited marine species. It has been caught in commercial quantities off the South African coast and used for fish meal and oil. The fish is very high in oil and analysis of the oil is reported.

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REMOVAL OF PESTICIDE RESIDUES FROM MENHADEN OIL. LEVENTE L. DIOSADY, Cambrian Processes Ltd., 2465 Cawthra Rd., Unit 112, Mississauga, Ontario, L5A 3P2, Canada.

A modular glass deodorizer consisting of eight contact stages was built. The unit operates continuously with a capacity of ca. 2 liters/hour. The contact mechanism approximates the performance of the Cambrian Compact Deodorizer. Samples of menhaden oil were treated in an attempt to reduce their pesticide residue content. A series of runs were made at different temperatures, pressures, and sparge rates. The free fatty acid content, DDT, eldrin, dieldrin, and polychlorinated biphenol (PCB) concentration in the oil and in the shell drain were analysed. The degree of polymerization of the oil was monitored. Optimum conditions were determined for removing the pesticide residues to legally acceptable levels while minimizing fatty acid losses. The oil quality was not affected by the treatment.

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STEPWISE REMOVAL OF CHLORINATED HYDROCARBONS DURING PROCESSING OF HERRING OIL FOR EDIBLE USE. R.F. ADDISON, Bedford Institute of Oceanography, and R.G. ACKMAN, Environment Canada, Halifax Laboratory, Dartmouth, Nova Scotia, Canada.

Residues of chlorinated hydrocarbon insecticides and of polychlorinated biphenols (PCB) have been examined in "naturally" contaminated marine oils subjected to pilot plant processing and refining. *p,p'*-DDE, *p,p'*-DDD, *p,p'*-DDT, PCBs and dieldrin stayed fairly constant (respectively ca. 1, 0.4, 0.5, 9 and 0.15 ppm) throughout a phosphoric acid wash, alkali refining, and bleaching. Upon hydrogenation, *p,p'*-DDD, *p,p'*-DDT and dieldrin dropped to below detectable levels (i.e. >90% reduction in all cases) while *p,p'*-DDE and PCBs dropped to about 20% and 30% of initial values. Deodorization removed final traces of the latter residues. The data are consistent with the more "polar" residues (*p,p'*-DDD, *p,p'*-DDT and dieldrin) being removed efficiently during hydrogenation, probably through adsorption on to the catalyst, while less polar residues (*p,p'*-DDE and PCBs) are only inefficiently removed at this stage. It is clear that complete processing, including deodorization, effectively removes all detectable traces of these common chlorinated hydrocarbon residues.

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FATTY ACID PROCESSING. ROBERT WIGGINS, Humko Sheffield Chemical, Memphis, TN.

Abstract not available at press time.

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FATTY ACID SITUATION IN EUROPE. THEO. E.A. ARTS, Akzo Chemie GmbH.

Abstract not available at press time.

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PRESENT AND FUTURE MARKETS FOR NATURAL FATTY ACIDS. R.M. HULL, Hull and Company, Bronxville, NY.

Abstract not available at press time.

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EXPANDING MARKETS FOR NATURAL FATTY ACIDS. Emery Industries, Cincinnati, OH.

Abstract not available at press time.

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ISOSTEARIC ACID. ROGER DANIELS, Union Camp Corp., Savannah, GA 31410.

Abstract not available at press time.

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FATTY ACIDS FOR DERIVATIVE USE. Armak, Chicago, IL.

Abstract not available at press time.

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HYDROGENATION CATALYSTS FOR FATTY ACIDS. V. DOHRER, Konigswarter and Ebell, Chemische Fabrik GmbH,

Abstract not available at press time.

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ATOMIC ABSORPTION SPECTROSCOPY SUBCOMMITTEE: PAST AND PRESENT ACTIVITIES. K.M. BROBST, A.E. Staley Mfg. Co., 2200 E. Eldorado St., Decatur, IL 62525.

This subcommittee was added to the Instrumental Techniques Committee in April, 1968. Since then the subcommittee has completed several collaborative studies during the investigation and evaluation of methods for the determination of trace metals in vegetable oils by atomic absorption spectroscopy. The first studies were made with a direct method by sample dilution with methyl isobutyl ketone. Results were judged acceptable and the procedure was added to the AOCS Methods Manual as Tentative Method Ca 15–75. Since then the graphite furnace technique has been investigated and two collaborative studies have been completed. Further studies of this technique are planned along with the writing of a method in AOCS format.

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INFLUENCE OF FLUORESCENT LIGHT AND COPPER ON ANTIOXIDANT AND PRO-OXIDANT EFFICIENCY OF CERTAIN FOOD ADDITIVES. M.H. CHAHINE, Nova Scotia Research Foundation Corporation, PO Box 790, Dartmouth, Nova Scotia, Canada, B2Y 3Z7.

Purified and distilled herring methyl esters were treated with 0.01% tertiary butylhydroquinone (TBHQ), propyl gallate (PG), butylated hydroxyanisole (BHA), and butylated hydroxytoluene (BHT), citric acid (CA) and ascorbyl palmitate (AP). The additives were added to the esters both individually and in various combinations. The treated esters were stored at 35 C and exposed to fluorescent light at an intensity of 94 footcandles. For comparison a second set of herring esters enriched with the same additives was kept in the dark at 35 C. The autoxidation reaction was followed by the weight gain method. Fluorescent light simultaneously accelerated the autoxidation of both herring esters and the incorporated antioxidants. As a result the protective factor of the tested antioxidants decreased by 50%. The relative inhibition effect of individual antioxidants decreased in the following order: TBHQ > BHA > BHT > PG, with respect to retardment of autoxidation of herring esters. This took place in stabilized herring esters both when exposed to fluorescent light and in the dark. The addition of TBHQ to herring esters stabilized with PG, BHT, and BHA resulted in antagonism with respect to the combined antioxidant effect of the examined stabilizers; this occurred in presence and absence of fluorescent light. In most cases CA had no or limited stabilizing effect on herring esters when added alone or together with antioxidants. AP exhibited pro-oxidant effect on herring esters when incorporated alone or together with antioxidants. The copper-AP complex which results from chelation of the copper originally present in the esters (<0.04 ppm) by AP, is known to have pro-oxidant effect. The influence of fluorescent light on the pro-oxidant effect of added AP to the esters was evaluated.

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FEASIBILITY OF TREATMENT OF STORED CRUDE OILS WITH TERTIARY BUTYLHYDROQUINONE AND OTHER ANTIOXIDANTS. PART II. INFLUENCE OF TRACE METALS AND FREE FATTY ACIDS. M.H. CHAHINE. Nova Scotia Research Foundation Corporation, 100 Fenwick Street, PO Box 790, Dartmouth, Nova Scotia, Canada B2Y 3Z7.

Crude herring oil was stored for 14 mo at 22 C alone and in the presence of the following additives: 0.02% tertiary butylhydroquinone (TBHQ), 0.02% propyl gallate (PG), 0.02% butylated hydroxyanisole (BHA), 0.02% citric acid (CA), 0.001% cupric chloride (Cu^{+2}), 0.002% Cu^{+2}, 0.001% ferric chloride (Fe^{+3}), and 0.002% Fe^{+3}, both individually and in various combinations. The autoxidation reaction was followed at regular intervals by measuring the increase in the level of secondary oxidation products, determined by the anisidine value (AV). At termination of the storage period, the AV of the untreated oil was equal to 49.9. In addition

and Cs, which are incapable of forming complexes with model ethers, reduced the cloud points, salting the surfactants out. The anions acted according to the Hofmeister series: I^- and ClO_4^- raised the cloud points because of their ability to break up the structure of water, while Br^-, NO_3^-, Cl^-, and SO_4^{--} lowered them with increasing effectiveness. The hydrotrope sodium xylenesulfonate raised cloud points appreciably. Of the symmetrical tetraalkylammonium cations, tetramethylammonium and ammonium reduced the cloud points, tetraethylammonium had a negligible effect, while tetra-*n*-propyl- and tetra-*n*-butylammonium raised them appreciably. The increases are ascribed to mixed micelle formation or hydrotropy. The changes in cloud point are used to evaluate current theories of salt effects on the solubility of nonelectrolytes. Krafft points in all electrolyte solutions remained within 4 C of those in pure water. Inorganic electrolytes which salted the surfactants out lowered their CMCs most extensively. Electrolytes which salted the surfactants in by raising their cloud points lowered the CMCs less extensively except for $Mg(NO_3)_2$ and $Cd(NO_3)_2$, which produced modest increases in CMC. All inorganic electrolytes examined reduced the cross-sectional area of the surfactant molecules adsorbed at the air/water interface.

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CONTROL OF COOLING TOWER ODORS IN EDIBLE OIL REFINERIES. JAMES F. BOURNER, Capital City Products Co., 525 W. First Ave., Columbus, OH 43215.

Many years of effort to control cooling tower odors have resulted in substantial progress but the problem is not completely solved. One of the primary reasons affecting the solution to the problem is the complexity of the product mix, not only in source oils, but in formulae. The presentation will be directed towards a threefold approach: (a) the use of chemicals in the cooling tower water to reduce the level of objectionable odors in the air emissions; (b) an upgrading of the importance of sanitation in the control of cooling tower odors; (c) a consideration of the closed loop odor abatement system which separates the clear cooling tower water from the greasy barometric water by the use of plate heat exchangers. Imparted odors through processing, when combined with natural odors, accentuate the difficulty of controlling and removing the objectionable characteristics.

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ROBERT SHAFFER, Effluent Guidelines Div., Office of Water Programs, EPA.

No title or abstract available at press time.

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G.N. MCDERMOTT, Procter & Gamble Co., Cincinnati, OH.

No title or abstract available at press time.

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KEITH BOOMAN, SDA Technical Director, New York, NY.

No title or abstract available at press time.

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CONFECTIONERY FATS: OVERALL REVIEW OF THE ART. VIGEN K. BABAYAN, Stokely-Van Camp Central Laboratories, 6815 East 34th St., Indianapolis, IN 46226.

This presentation reviews the state of the art on the confectionery coatings and the hard butters which have evolved as their acceptance and application has developed over the years. The various types of hard butters and the role they play in conjunction along with chocolate and cocoa will be identified. The practices and the areas of utilization of the different types of products and the raw materials from which they are derived will be described. Raw material costs vs. confectionery prices over the years as well as the availability of such ingredients in the future will be reviewed. The trends and needs of the future in realistic terms and overall considerations for the industry and the public will be discussed.

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FRACTIONATED HARD BUTTERS. ALEXANDER E. THOMAS III and ANTHONY G. HERZING, Durkee Foods, Division of SCM Corporation, Dwight P. Joyce Research Center, 16651 Sprague Rd., Strongsville, OH 44136.

Principles of fractional crystallization are reviewed and idealized single- and multistage unit processes are described. Source oils and solvents typically employed in the preparation of hard butters by solvent fractionation are discussed. Several hard butter compositions and their properties are presented with emphasis on those properties which affect organoleptic, functional, and thermal characteristics. Physicochemical data are employed to compare properties of solvent fractionated hard butters with those of naturally occurring hard butter, as well as with those produced by chemical modification alone. Finally, several confectioners' coatings are shown which illustrate the effect of hard butter properties on important characteristics of confectionery coatings typically used in the candy and bakery industries.

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FRACTIONATED LAURIC HARD BUTTERS AND THEIR APPLICATION IN CONFECTIONERY COATINGS. JULIUS R. BRODBECK, JR., Capital City Products Co., Div. Stokely-Van Camp, 525 W. First Ave., Columbus, OH 43216.

Methods of fractionation are mentioned, and the manner in which fractionation alters the analytical constants of palm kernel oil is discussed. The effects of hydrogenation on the solid fat index are presented. The softening actions of cocoa butter and butter oil on hydrogenated fractionated palm kernel (HFPK) are discussed in regard to formulating dark and milk chocolate counterparts. Formulating meltaway centers with mixtures of HFPK and chocolate are discussed.

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MANUFACTURE OF HARD BUTTERS BY HYDROGENATION AND INTERESTERIFICATION OF OILS AND FATS. J.G. MARCUS and P.S. PURI, Best Foods Research and Engineering Center, Union, NJ.

Certain oils and fats when hydrogenated or hydrogenated and subsequently interesterified result in products which are brittle at and below room temperature and melt completely or nearly completely at body temperature. These products are called hard butters or cocoa butter substitutes because of the nature of their application. The principles of hydrogenation and interesterification from the viewpoint of obtaining hard butters are discussed at length. Commercially produced hard butters using these processes are reviewed. A typical example of hard butter produced by hydrogenation alone is from soybean oil which is hydrogenated under such conditions so as to obtain a maximum of *trans*-isomers. This fat is used in the preparation of confectionery coatings mainly for crackers and cookies and as a dairy fat substitute. Hard butters of better eating qualities can be obtained by interesterifying different hydrogenated fat blends or by interesterifying a single hydrogenated fat. Examples of this class are hydrogenated and interesterified palm kernel oil and an interesterified blend of hydrogenated palm kernel oil with or without palm oil and cocount oil. These products are used as cocoa butter substitutes in formulating confectionery coatings. The suitability of different hard butters produced by hydrogenation and interesterification of oils and fats for certain applications and their economics in comparison to the fractionated hard butters are discussed.

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HARD BUTTERS IN ALLIED FOOD USES.

Speaker and abstract not available at press time.

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PHYTIC ACID REMOVAL FROM SOYBEANS BY A LIPID PROTEIN CONCENTRATE PROCESS. J.R. FORD, G.C. MUSTAKAS, and R.D. SCHMUTZ, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

Over 90% of phytic acid has been removed from full-fat soy flour by a lipid-protein concentrate process previously reported in 1974 by the Northern Regional Research Center. In the current study, parameters for optimizing phytic acid removal were evaluated. By changing pH and molar concentration of the calcium solution in the initial acid slurry, various amounts of phytic acid and mineral elements were recovered in the acid-precipitated curd. A mathematical treatment using multiple regression analysis showed phytic acid removal possible from 10 to 90%, zinc recovery from 10 to 90%, and calcium concentrations equalling twice that of the original starting flour. These variable conditions introduced into the process had no effect on protein (91–92%), fat (98–100%), and iron (94–96%) recoveries.

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CONVERSION OF CHEESE WHEY TO YEAST OIL AND PROTEIN. (HONORED STUDENT PRESENTATION). NANCY J. MOON and E.G. HAMMOND, Department of Food Technology, Iowa State University, Ames, IA 50011.

Cheese whey is typical of many by-products of the food processing industries, being rich in carbohydrate and poor in nitrogen. Conversion of whey by fermentation to yeast oil and protein would be an economically attractive method of disposal if the process was complete and efficient. Four yeasts were isolated that could ferment the lactose in whey and produce oil. Optimum conditions of pH, agitation, aeration, and temperature for growth and oil formation were established for each yeast in a 10-liter fermenter. The fermentation was complete in 48–72 hr; and for two of the yeast species, lactose was completely used. For the other two, about half the lactose was used. All four species used whey protein poorly, and ammonia and inorganic salts were required for maximum cell densities. The chemical oxygen demand was reduced ca. 85% by the species using lactose completely. Much of the residual chemical oxygen demand was protein, so prior harvesting of the protein by membrane filtration appears to be the most attractive process. The fat yield was 5–10 g/liter of whey and the optimum temperature for conversion at 28 to 32 C. The fat composition was 28% 16:0, 16% 18:0, 51% 18:1, and 5% 18:2.

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PHYTOSTEROL CONTENT OF FOODS. JOHN L. WEIHRAUCH, ARS, USDA, CFEI, Room 300, Federal Building, Hyattsville, MD 20782, and JOHN GARDNER, University of Maryland, College Park, MD.

Data on the total sterol content and composition of a wide variety of foods of plant origin are currently being collated for use in U.S. tables of food composition. Our search of the recent literature (since 1960) revealed that analytical data were frequently reported in relative units relating each sterol to the total sterol mixture (percent) or relating each sterol to a reference component which was usually β-sitosterol. Described are factors affecting the variability of the data and problems in converting analytical data to absolute units suitable for tables of food composition e.g. mg of sterol per 100 g of food. Current analytical procedures for the quantitation of the sterols are discussed. Data gaps and conflicting reports in the literature are identified as a guide for further research.

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THE EFFECT OF FUNGAL INFECTION UPON FREE FATTY ACID LEVELS OF SAFFLOWER SEED. THOMAS C. HEATON, D.S. MIKKELSEN, P.F. KNOWLES and J.E. RUCKMAN, Department of Agronomy and Range Science, University of California at Davis, Davis, CA 95616.

In recent years processors of California Safflower, *Carthamus tinctorius* L., have noted free fatty acid (FFA) values greater than 0.25% (as oleic acid) making caustic refining a necessity before deodorization of the oil. In 1975 FFA reached 0.50% in hand sampled achenes from the Sacramento Valley, while San Joaquin Valley samples never exceeded 0.10% FFA. The geographic occurrence of FFA was linked to an *Alternaria* sp. which predominated in the pericarp of Sacramento Valley achenes. Achenes with thinner pericarps (higher oil content) seemed more susceptible. Greenhouse inoculations of the *Alternaria* isolate on four representative safflower cultivars caused 25% lower yield (g seed/head), 8% lower oil content, and eight times higher FFA overall than found in control plants. In vitro studies with the *Alternaria* sp. and four other safflower fungi demonstrated that all five have lipolytic capabilities, with the *Alternaria* sp. producing 3.90% FFA after 20 days growth on safflower oil-potato dextrose agar medium. Separation by thin layer chromatography (TLC) and characterization by gas liquid chromatography (GLC) of the FFA caused by all five fungi revealed random cleavage of the fatty acids from the safflower triglyceride molecule. Fungicide trials in the Sacramento Valley in 1976 indicated that fungal infection and FFA levels increase as safflower harvest is delayed.

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FIELD EVALUATION OF EXTRACTION PERFORMANCE. EDWARD D. MILLIGAN and DAVID C. TANDY, EMI Corporation, 3166 Des Plaines Ave., Des Plaines, IL 60018.

Two factors affect the efficiency of extraction for a percolation type oilseed solvent extractor. The first is extractability of the oilseed, which is a measure of the ability of the solvent to permeate the structure of the seed, extract the oil from the matrix, and move to the surface of the seed. The second is washability, which is a measure of the ability of the bed to permit removal of surface oil from the seed by contact with washes of successively fresher solvent. This relates to the physical bed conditions which allow for optimum flow of solvent through the bed and maximum drainage rate from the bed. Several practical methods of determining these factors in the field are presented and discussed, and the effects of seed properties such as moisture, flake thickness, fines and the bed density achieved in the extractor are examined.

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EFFECT OF STAGE OF MATURITY ON THE CHEMICAL COMPOSITION OF SUNFLOWERSEED AND ITS RELATIONSHIP TO PHYSIOLOGICAL MATURITY. JAMES A. ROBERTSON, ARS, USDA, R. B. Russell Agricultural Research Center, Field Crops Laboratory, PO 5677, Athens, GA 30604.

Hybrid sunflowerseed were collected from growing plants at 7 day intervals after the initiation of flowering. The seed were analyzed for moisture, dry weight, total oil, free fatty acids, and fatty acid composition. Flowering began 58 days after planting. Maximum achene (seed) dry weight and oil content were obtained 35 days after the initiation of flowering (DAF) when the achene moisture content was about 36%. This point was defined as "physiological maturity" for sunflowers. The fatty acid composition of the oil extracted from the seed was determined at each stage of maturity. At 7 DAF, linolenic acid content was high (10.7%) but decreased to less than 0.1% by 28 DAF. Linoleic acid initially decreased to 22.6% by 14 DAF, but then gradually increased to 59.2% by 56 DAF. On the other hand oleic acid initially increased to 59.6% at 14 DAF and then gradually decreased to 31.4% at 56 DAF. Fatty acid composition continued to change after the seed were physiologically mature. The changes appeared to be related to the environmental temperature which gradually decreased during the period of study. Increase in free fatty acids after physiological maturity indicated that deterioration of seed oil was occurring.

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LIPIDS OF DEFATTED SOY FLOURS DURING STORAGE. SHARON L. MELTON and RICHARD E. MOYERS, University of Tennessee, Department of Food Technology and Science, PO Box 1071, Knoxville, TN 37901.

Three treatments of defatted soy flour (1, fully toasted; 2, white; and 3, enzyme active) 92 days post production date were stored at 23 C for 0, 60, 120, and 180 days. Five replications of each flour were stored and each replication represented a given production date. The lipoxygenase activity, thiobarbituric acid number (TBA), Nitrogen Solubility Index (NSI), and % extractable lipid were determined for all soy flours at each storage time. The extractable lipid was quantitatively separated into three fractions by elution from a silicic acid column with (I) $CHCl_3$:CH_3:OH, 20:1, v:v; (II) $CHCl_3$:CH_3OH, 1:1, v:v; and (III) CH_3OH. Lipids in each fraction were separated by thin layer chromatography and attempts were made to identify the lipids. The relative amounts of fatty acids (C_{14}-C_{20}) present in each fraction were determined by gas liquid chromatography. Significant differences were found among the flours for lipoxygenase activity, TBA, NSI, and extractable lipid. Lipoxygenase activity of the enzyme active flour decreased at an increasing rate during storage. TBA of each flour and the mean % extractable lipid from all flours decreased during storage. No differences were found among soy flours or storage times for the number and types of lipids in any of three fractions. An average of 29.6% of the extractable lipids was found in Fraction I (glycerides, glycolipids, and steroids), and Fraction II contained 56.7% (phosphatidyl inositol, lecithin, cephalin, glycolipids, and steroids). Fraction III (13.7% of extractable lipid) was mainly lecithin. The relative percent linoleic acid in each lipid fraction of the fully toasted and white flours decreased significantly during storage, but the relative percent linoleic in each lipid fraction of the enzyme active flour did not change during storage. At the beginning of storage, the percent linoleic acid in each lipid fraction of enzyme active flour was considerably lower than that of fully toasted or white flour.

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SEED FAT FROM *Eschscholzia Californica*, CALIFORNIA POPPY. OSTEN LEVIN and CHRISTINA ERIKSSON, Margarinbolaget, Stockholm, Sweden.

Seeds from *E. californica* contain a substantial amount of oil, about 40% of dry matter. When the plant is grown in Swedish climate the oil contains about 55% of linoleic acid, and 3% of linolenic acid, the rest being mainly oleic and palmitic acid. The extracted oil contains one or more substances having strong ultraviolet absorption with a maximum at 284 nm, and somewhat weaker absorption bands in the region 325–360 nm. Upon standing and contact with air, the oil turns pink. These substances probably contain aldehydic groups as shown by the reaction with p-anisidine.

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HYDROGENATED SUNFLOWERSEED OIL: OXIDATIVE STABILITY AND POLYMER FORMATION ON HEATING. W.H. MORRISON and J.A. ROBERTSON, ARS, USDA, R. B. Russell Agricultural Research Center, Field Crops Laboratory, PO Box 5677, Athens, GA 30604.

The effects of hydrogenation on the oxidative stability and polymer formation associated with heated northern and southern sunflowerseed oil were studied. Light hydrogenation increased the overall stability of both oils but did not alter the rate of loss of oxidative stability on heating. Polymer build-up in the oils reached a maximum of 3.5% with no indication of preferential absorption by potatoes prepared in the oils.

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NEW NATURAL SOURCES OF ACETOTRIGLYCERIDES. CECIL R. SMITH, JR., and RICHARD V. MADRIGAL, Northern Regional Research Center, ARS, USDA, Peoria, IL.

Some unusual triglycerides from seed oils of *Polygala virgata* and *Securidaca longipedunculata* (family Polygalaceae) have been characterized. Previous work on *Monnina emarginata* seed oil (of the same plant family) revealed a series of unusual triglyceride components, including estolides based on *S*-coriolic (*13 L-hydroxy-cis-9,trans-11-octadecadienoic*) acid. *Polygala* and *Securidaca* produce some similar triglycerides, but differ in having high proportions of monoacetotriglycerides not found in *Monnina*. The principal component of *Polygala* seed oil is an acetoglyceride, and it has the acetate group exclusively at position 2 of *sn*-glycerol instead of at position 3 as in acetoglycerides previously found in nature. This assignment is based on evidence from thin layer chromatography, optical rotatory dispersion, and pancreatic lipolyses. *Securidaca* produces a complex mixture of triglyceride components, including some acetoglycerides, which are separable by chromatography.

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THE EFFECT OF TYPE V HYPERLIPOPROTEINEMIA ON THE STRUCTURES OF TRIACYLGLYCEROLS, PHOSPHATIDYL CHOLINES, AND CHOLESTEROL ESTERS IN EACH OF THE LIPOPROTEIN CLASSES. KATHLEEN E. MCMAHON, SHIRLEY A. GERRIOR, MARY M. HAGERTY, and ROBERT G. JENSEN, University of Connecticut, Department of Nutritional Sciences, Storrs, CT 06268.

Previous data from our laboratory showed a difference in very low density lipoprotein (VLDL) and low density lipoprotein (LDL) triglyceride (TG) structure in a subject with Type IIa hyperlipoproteinemia (HLP) as compared to the TGs from a normal person. Continuing this work, we have obtained fasting blood samples from normal [cholesterol (C) (C < 300 mg/dl, TG < 150 mg/dl] and untreated Type V HLP (C 300+ mg/dl, TG 800+ mg/dl) human subjects. VLDL, LDL, and high density lipoprotein (HDL) classes were isolated by preparative ultracentrifugation· purity was checked by agarose gel electrophoresis. The samples were delipidated by Folch extraction. TGs, phospholipids (PL), and cholesterol esters (CEs) were isolated from each lipoprotein class by preparative thin layer chromatography (TLC). The fatty acid (FA) composition of the CEs was determined by analyzing their methyl esters with gas liquid chromatography (GLC). Stereospecific analysis was used to isolate the fatty acids from the *sn*-1 and *sn*-2 positions on the TG and PL samples. These were converted to their methyl esters and analyzed by GLC. For the TGs, the FA composition of the *sn*-3 position was determined by difference from the residual TG. Data will be presented on the structures of the lipid classes and implications will be discussed.

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INFLUENCE OF α-TOCOPHEROL ON FUNGAL LIPIDS DURING AGING. MICHELE SBASCHING and R. CECIL JACK, Department of Biological Sciences, St. John's University, Jamaica, New York, NY 11439.

When the growth medium of the fungus *Glomerella cingulata* is supplemented with α-tocopherol, triacylglycerol content is increased but phospholipid content remains virtually unchanged. To determine the role of biosynthetic reactions in this result, we have followed the incorporation of 5 uCi of U-^{14}C-glucose into 100 ml samples of control and tocopherol treated cultures at 48, 60, 72, and 96 hr of age. In all cases, treatment with α-tocopherol decreased the incorporation of ^{14}C-glucose; however, the extent of the decrease varied from one class of lipid to another and from age to age. When the data were expressed as ratios of specific activities (radioactivities of lipids from control/those from treated cultures) the following results were obtained: at 48 hr, phosphatidylethanolamine (PE) 8.8:1; phosphatidyl inositol (PI) + phosphatidyl serine (PS) 1.8:1; phosphatidyl choline (PC) 1.1:1. At 60 hr the ratios were PE 1.3:1; PI + PS 1.6:1; PC 1.1:1. At 72 hr the ratios were PE 3.7:1; PI + PS 4.1:1; PC 5.8:1. At 96 hr the ratios were PE 1.0:1; PI + PS 1.2:1 and PC 2.1:1. At the four ages, the specific activities of the phospholipids varied in the order PE > PI + PS > PC. Treatment with α-tocopherol also decreased the incorporation of ^{14}C-glucose into the triacylglycerols but, both in the control and treated cultures, there was greater incorporation of ^{14}C into the phospholipids than into the triacylglycerols. When combined with previous data, these results suggest that the increased content of triacylglycerols in treated cultures was due to decreased breakdown rather than increased synthesis and that the phosphoglycerides underwent significant changes in composition through a combination of de novo synthesis and deacylation-reacylation reactions. Experiments on the incorporation of 2-^{14}C-acetate are in progress.

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THE CRYSTAL STRUCTURES AND STABILITIES OF THE β-2 AND β-3 MODIFICATIONS OF SATURATED TRIGLYCERIDES. T.C. VAN SOEST and S. DE JONG, Unilever Research, Vlaardingen, The Netherlands.

Through a judicious combination of experimental information (e.g. the known crystal structure of CCC, long spacings and melting points) and general crystal packing considerations (e.g. the principle of close packing, the T// subcell packing mode for hydrocarbon chains) our knowledge of the β-2 and β-3 polymorphic modifications of even saturated triglycerides has been greatly increased: (a) Five β-2 submodifications can be distinguished (types A, B, C, D, and E) which mainly differ as regards to their methyl group arrangement (or methyl terrace). (b) In principle exactly three kinds of triglycerides can have a similar β-2 structure with equal methyl terrace. For example MPS, PSP, SPS and homologues—forming what we call a quasi-homologous series—have been observed in the β-2 form of type B. (c) The melting points of the members of such a quasi-homologous series define a smooth curve provided that the melting points of the asymmetric triglycerides which usually are racemic mixtures are corrected (by ca. +5 C) for the effect of the entropy of mixing in the melt. Properties 2 and 3 have been employed to study the crystal structures of four classes of β-3 phase triglycerides $C_pC_qC_r$, where r = p, p + 2, p + 4, or p + 6 and q differs by at least 4 with p or r. The following results have been obtained. (a) There are two distinct β-3 submodifications (types A and B). (b) The triglycerides $C_pC_qC_{p+2}$ and $C_pC_qC_{p+4}$ crystallize in the high melting form of type A. The low melting form (of type B) is associated with the triglycerides $C_pC_qC_p$ and $C_pC_qC_{p+6}$. It can be deduced from the crystallization behavior and the melting points of the various triglycerides that the above β-2 and β-3 forms must have different stabilities. The stabilities of the principal submodifications decrease in the order β-2D, β-2A, β-2C, β-3A, β-2B,

β-3B. There is a correlation between this order and the nature of the methyl terraces present in the submodifications concerned.

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THE CRYSTAL STRUCTURES OF POP, POS, OSO AND HOMOLOGUES IN THE β-3 FORM. THE PHASE V → PHASE VI TRANSFORMATION OF COCOA BUTTER. T.C. VAN SOEST and S. DE JONG, Unilever Research, Vlaardingen, The Netherlands.

By applying general crystal packing principles (close packing, $T_{//}$ subcell packing mode for the hydrocarbon chains) and using information derived from the melting points and long spacings the crystal structures of POP, POS, OSO and homologues have been derived. It appeared that POP and POS and their homologues have a similar crystal structure, i.e. molecular conformation; packing and methyl group arrangement are the same. From the doubling of the short spacings near 3.8 Å in the diffraction photographs of these triglycerides it can be deduced that the crystal structure probably is triclinic. In view of our findings concerning the packing around the methyl groups in the β-2 and the β-3 forms of the saturated triglycerides, the triclinic stacking of the molecular layers is not the most advantageous one. A better stacking would be the one where two successive layers are related by a center of symmetry giving a monoclinic structure. An additional consequence would be that the short spacings will not be doubled in this case. As the phase transformation (V → VI) in cocoa butter is attended with a change in diffraction pattern near 3.8 Å (4 lines → 2 lines), and the long spacing keeps constant, we assume that a recrystallization takes place from a triclinic into the more stable monoclinic form. The crystal structure of β-3 OSO and homologues has been derived in a straightforward manner from that of POP.

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TRAPPING AND IDENTIFICATION OF VOLATILES PRODUCED DURING THERMAL OXIDATION OF SOYBEAN OIL. TOM RIISOM, Grindstedvaerket A/S, Denmark.

The processes taking place during thermal oxidation of vegetable oils have been subject to intensive studies. A number of methods have been developed to fractionate the thermally oxidized oils, and the "new chemical species" formed during oxidation have been described in great detail although there are still quite a few questions which await answers. However, only a few studies have been concerned with the identification of volatiles produced during oxidation. This paper describes the methods used to trap and identify the volatiles evolved when soybean oil is heated in the presence of air. Soybean oil has been heated to 200 C for 12–16 hr. During the heating period, air is blown through the oil at a rate of 60 ml/min/5 g oil. The volatiles formed during the oxidation of the oil are swept out of the reaction vessel by the airstream and passed through a glass tube packed with activated charcoal. The volatiles adsorbed to the charcoal are desorbed with carbondisulfide and subjected to gas liquid chromatography-mass spectrometry (GLC/MS) analysis. The identified compounds include aldehydes, ketones, acids, and alkanes. In a similar experiment the time course of the reactions is followed by sampling the airstream from the reaction vessel every 2 hr during the process and again analysing the volatiles thus trapped following the procedure described above. On the basis of the differences in the chromatograms, some reaction pathways responsible for the degradation of soybean oil are discussed.

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EFFECTS OF ETHANOL ON LIPID PRODUCTION IN A FUNGUS. MARIE L. DALPIAZ, ALIX J. CHENET, and R. CECIL JACK, Department of Biological Sciences, St. John's University, Jamaica, New York, NY 11439.

Fungi and yeasts can produce large proportions of ethanol from glucose, but very little information is available on whether ethanol affects lipid production in fungi as is the case in higher forms. This report deals with the effects of added ethanol on lipid production in the fungus *Glomerella cingulata* at 48, 96, or 120 hr of age. The nutrient media contained isocaloric levels of the appropriate carbon sources, 37 kcal of glucose or 37 kcal of glucose + ethanol. Ethanol was tested at three levels: 10, 25, and 50% of the total calories. At 48 hr, total lipid generally was lower in the cultures grown with ethanol, but cell mass (dry wt) and protein content increased relative to control cultures (those grown with glucose but without ethanol). At 48 hr also, 25% ethanol gave higher yields of total lipid, protein and cell mass than 10% and 50% ethanol whereas 10% ethanol gave higher yields of protein than 50% ethanol and approximately the same yield of total lipid as 50% ethanol. Phospholipid content varied in the order 25% ethanol > 50% ≅ 10% ethanol. At 96 and 120 hr of age, in contrast to 48 hr, 25% ethanol cultures contained higher levels of triacylglycerols and phospholipids than control cultures, but triacylglycerol content was greater than phospholipid content at all ages, and the highest levels of lipid content in ethanol supplemented cultures were those observed in 96 hr cultures. Thus, age affected the lipid content of control and ethanol-supplemented cultures differently. Protein content also changed in different ways with age: compared with control cultures, the protein content of cultures grown with ethanol decreased at 120 hr but increased at 48 hr.

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CHOLESTERYL ESTER METABOLISM IN THE ADRENAL GLAND. DAVID M. CREECH, ALBERT Y. SUN, and GRACE Y. SUN, Sinclair Comparative Medicine Research Farm, Route 3, University of Missouri, Columbia, MO 65201.

It is generally recognized that the adrenal gland is an important endocrine system in the body for synthesis and metabolism of steroid hormones. A large portion of the cholesterol in the adrenal is stored in the esterified form linking to long chain polyunsaturated fatty acids. The cholesteryl ester content in adrenals is different with respect to sex and age and may vary when animals are subjected to external stimuli and stress. Furthermore, recent dietary study indicates that rats reared with a vitamin E deficient diet had a higher level of cholesteryl esters (~200%) in the adrenals as compared to the ones fed a vitamin E supplemented diet. The cholesterol level in the adrenals of vitamin E deficient rats was also higher (50%). It is not known whether the accumulation of cholesteryl esters in adrenals during vitamin E deficiency may be related to a decrease in cholesteryl hydrolase activity. Cholesteryl oleate hydrolase activity was assayed in the microsomal fraction of rat adrenals. The pH optimum for the enzyme was around 5.5. The enzymic hydrolysis was linear with time up to 4 hr of incubation at 37 C. Triton-TW 1339, a cholesterol mobilizing agent, inhibited the hydrolase activity, whereas taurocholate and low concentration of ethanol (1%) stimulated the enzymic activity. Results thus indicate that enzymic hydrolysis of cholesteryl esters may play an important role in regulating the availability of substrate for subsequent steroid hormone synthesis. This enzyme mechanism may also be affected by various types of hormone-stimuli responses. (Supported in part by USPHS grants NS-12960 and NS-12752.)

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GLYCOLIPIDS OF HUMAN GASTRIC SECRETION. AMALIA SLOMIANY, BRONISLAW L. SLOMIANY, and GEORGE B.J. GLASS, Gastroenterology Research Laboratory, Department of Medicine, New York Medical College New York, NY 10029.

Our studies on lipid composition of the human gastric secretion indicated the presence of a novel type of glycolipids and the absence of glycolipids commonly found in the gastric mucosa. The glycolipids were isolated from pentagastrin stimulated human gastric secretion by the procedure involving extraction of lipids with chloroform-methanol (2:1), column chromatography on DEAE-Sephadex and Silicic acid, followed by thin layer chromatography in three different solvent systems. Application of this procedure resulted in the isolation of several neutral and acidic glycolipids. Analyses performed on the major acidic glycolipid have shown the presence of glucose, glycerol, and sulfate in a molar ratio of 3:1:1. The long chain bases were not detected. The migration of this compound on thin layer plates was retarded by mild alkaline methanolysis and enhanced by desulfation. The carbohydrate portion of this glycolipid was found to be attached either to diacyl-glycerol or monoalkyl-monoacyl-glycerol. Acyl portion consisted mainly of palmitate whereas chimyl alcohol was the predominant glyceryl ether. (Supported by Grant AM-00068-24A1 from NIAMDD, NIH, PHS.)

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FATS AND OILS, THE HISTORICAL COSMETICS. MAISON DE NAVARRE, Vanda Beauty, Orlando, FL.

Abstract not available at press time.

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USE OF FATTY ACID DERIVATIVES IN COSMETICS AND TOILETRIES. DALE JOHNSON, Armak, Inc., Chicago, IL.

Abstract not available at press time.

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OILY COMPONENTS IN COSMETICS FROM A EUROPEAN VIEW. H. KROKE, Henkel KGaA, Dusseldorf, Germany.

Abstract not available at press time.

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LANOLIN AND ITS DERIVATIVES. M.L. SCHLOSSMAN, Malmstrom Chemicals, Linden, NJ.

Lanolin, which is extensively used in pharmaceuticals and cosmetics is generally considered to consist of a mixture of natural formed esters derived from higher alcohols and higher fatty acids. My presentation will encompass the chemical description of Lanolin; the composition of its esters, acids, and alcohols; the chemical and physical modifications of Lanolin; the refining of Lanolin; and some of its applications in pharmaceutical and cosmetic formulations. Some new and interesting developments in Lanolin chemistry will also be highlighted.

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PHYTOLIPIDS IN PERSONAL CARE PRODUCTS. L. LUNDMARK, General Mills, Minneapolis, MN.

Abstract not available at press time.

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CASTOR OIL—A NATURAL COSMETIC INGREDIENT. K. FOZDAR, F. DUNECZKY, and F.C. NAUGHTON, Industrial Chemicals Division, NL Industries, Inc., PO Box 700, Hightstown, NJ 08520.

Castor oil has been known to the pharmaceutical industry for a long time as a cathartic and pharmaceutical aid. Castor oil, a natural emollient and lubricant, is obtained from the seeds of *Ricinus communis* and is composed mainly from the triglyceride (ester) of ricinoleic acid. The hydroxyl groups, double bonds, and ester linkages in castor oil provide reaction sites for the preparation of many useful derivatives that have found their way into cosmetic formulations. This paper discusses the preparation of waxes, plasticizers, surfactants, water soluble waxes, and soaps of castor oil through different chemical reactions. Physical and chemical properties of castor derivatives are presented. The asthetic quality and unusual properties that are achieved by castor derivatives are depicted in different cosmetic formulations. A brief comparison of castor oil with several other vegetable oils will be made.

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EMI EDIBLE OIL DEODORIZING SYSTEMS. ARNOLD M. GAVIN, EMI Corp., 3166 Des Plaines Ave., Des Plaines, IL 60018.

Process requirements for proper deodorization of edible oils, and the mechanical design of EMI Deodorizers to meet these requirements will be discussed. Also to be explained are single and double shell deodorizers, physical refining deodorizers, and auxiliaries such as internal heat recovery, deodorizer distillate recovery, and automatic change of feed stock.

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OLD AND NEW IN WINTERIZING. GEORGE M. NEUMUNZ and RICHARD NASSER, Neumunz Inc., 117 Fort Lee Rd., Leonia, NJ 07605.

This paper will discuss old and new methods of winterizing, batch and continuous; also, the techniques required for various oils, such as cottonseed oil, soybean oil winterizing, as well as de-waxing sunflower seed and corn oil.

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CAMPRO. R.S. JICKLING, Campro, Cambrian Processes Ltd., 2465 Cawthra Rd., Mississauga, Ont., Canada L5A 3P2.

This presentation will include: (a) introduction to Campro (Cambrian Processes Limited); (b) discussion on technical capability, including research and development facilities and pilot plant equipment for seed preparation, extraction, oil refining and protein processing; (c) Campro deodorizer; (d) Campro physical refining system.

SESSION CHAIRMEN

AUTHOR INDEX

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